A SYSTEMATIC STUDY OF THE GENUS BAHIA (COMPOSITAE)[1]

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GENERIC RELATIONSHIPS

An introduction to the problem of generic relationships was given in the chapter on taxonomic history. The first serious attempts to ascertain the generic interrelationships between *Bahia, Schkuhria*, and *Eriophyllum* were made by Gray (1849, 1884). More recently, Constance (1937) has given attention to the distinctions between *Bahia* and *Eriophyllum*, and Heiser (1945) has briefly discussed the intergeneric problem of *Bahia* and *Schkhuhria*.

Whereas biochemical studies will undoubtedly prove to be significant in indicating the relationship between *Eriophyllum* and *Bahia*, morphological characters together with chromosomal information and geographic distribution are sufficiently distinct that the recognition of them as two genera is clearly justified.

The problem of *Bahia* and *Schkuhria* has not been so well resolved. Heiser (1945) recognized the difficulty quite fully and indicated the need of additional study "when more specimens of *Bahia* are available." I am in accord with his inclusion of the taxon *Schkuhria multiflora*[7] in *Schkuhria* rather than in *Bahia*, although additional evidence should be accumulated to support this conclusion.

S. multiflora is an erect annual with opposite leaves and it occurs for the most part in moist habitats at high elevations. In these respects it resembles "true" *Schkuhria* as represented by *S. pinnata*, etc. Certainly the most conspicuous character indicating the affinity of the species to *Schkuhria* is the fact that it is discoid. *S. multiflora* does not have keeled bracts as do species of "true" *Schkuhria*, but rather they usually are cupped and partially enclose peripheral achenes in a manner not commonly found in *Bahia*. Petaloid margins on the bracts, consistently found in *S. multiflora*, are more characteristic of *Schkuhria* than of *Bahia*. Shinners (1951) considered the floral morphology of *S. multiflora* to be more like that of *Bahia* but I do not find the total comparative evidence to be so compelling.

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[1] Continued from page 86 (Jan.-March 1964).

[7] The North American element of this species has been known as *Bahia neomexicana* Gray (Proc. Am. Acad. 19:27. 1883).

Schkuhria multiflora showed a distinct departure from all species of *Bahia* with respect to the time of meiosis in pollen mother cells. Meiosis occurs at an early stage of bud development in species of *Bahia*, but it takes place at an exceptionally juvenile stage in *Schkuhria multiflora*, as it does also in species of "true" *Schkuhria*. Although no detailed studies of comparative chromosome morphology were conducted, it should be noted that the meiotic chromosome morphology of *S. multiflora* is more like that found in species of *Schkuhria* than of *Bahia*.

Rydberg (1941) included the following genera in the subtribe Bahianae: *Loxothysanus, Picradeniopsis, Bahia, Platyschkuhria, Hulsea, Amauriopsis, Vasquezia, Galeana* and *Achyropappus*. Although the present study does not concern the subtribe as such, some consideration of it seems desirable on the basis of present information. According to Turner (1962), it is likely that *Loxothysanus* belongs to the Eupatorieae; *Hulsea* shows characters suggestive of the tribe Senecioneae (Turner, personal communication). Turner (1962) further suggests that *Hymenothrix, Florestina* and *Schkuhria* (including *Tetracarpum* and *Cephalobembix*) of Rydberg's *Hymenopappanae* be placed, at least tentatively, in the subtribe Bahianeae. In the present treatment *Picradeniopsis* and *Amauriopsis* have been submerged in the genus *Bahia*. As reconstituted along the lines suggested by Turner, the subtribe Bahianeae would consist of the following genera: *Achyropappus, Bahia, Florestina, Galeana, Hymenothrix, Platyschkuhria, Schkuhria* and *Vasquezia*.

Some attention needs to be called to the submergence of both *Picradeniopsis* and *Amauriopsis* in *Bahia*. Rydberg (1914) distinguished *Picradeniopsis* as a genus (of two species) on the following morphological bases: campanulate involucre, keeled bracts and conspicuously impressed-punctate foliage. Both of the species in the genus are characterized by these features; however, their leaf shape and particularly their floral morphology indicate a close affinity to *Bahia*. Chromatographic evidence on *B. woodhousei (Picradeniopsis woodhousei)* reveals it to be quite distinctive. Chromosomal data and additional chromatographic information are needed. Future study may indicate Rydberg's treatment to be the more natural.

The monotypic genus *Amauriopsis* Rydberg was distinguished by him on the basis of the length of the disc corolla lobes plus the absence of a pappus. Pappus scales occur occasionally in the species, however, and total morphology suggests that it be included in *Bahia* as circumscribed in this study. Chromatographic evidence supports this view, and the chromosome number, although different from all others in the genus, offers no obstacle to the possible origin of *B. dissecta (Amauriopsis dissecta)* from a common ancestral complex for the genus *Bahia* (see the chapter on chromosomal studies).

Rydberg (1914) separated the perennial taxa with woody caudices and alternate leaves of Gray's *Bahia* into a separate genus, *Platyschkuhria*. This genus seems quite properly placed in the Bahianeae, and it is obviously close to *Bahia*. However, I believe that present evidence indicates Rydberg to have been correct in his judgment. Not only does *Platyschkuhria* differ from *Bahia* in its habit, root and leaf character, but also in certain floral features; e.g., there are no species of *Bahia* with cylindro-campanulate corollas. A single chromosome count of $n = 12$ has been reported by Raven and Kyhos (1961). This accords with not only *Bahia* but with *Florestina* and *Hymenothrix* as well. A critical study of the genus is needed in order to properly assess its relationship in the subtribe.

DISTRIBUTION AND ECOLOGY

Bahia, as circumscribed in the present treatment, is bicentric in distribution. Only one taxon (the type species, *B. ambrosioides*) is found in South America (Chile), while all others occur in central and northern Mexico and in the southwestern and western United States. The South American species, belonging to series Oppositifoliae, is found in coastal regions, although it exhibits xerophytism, as do some of its North American counterparts. Members of the series Alternifoliae occupy, for the most part, relatively mesic

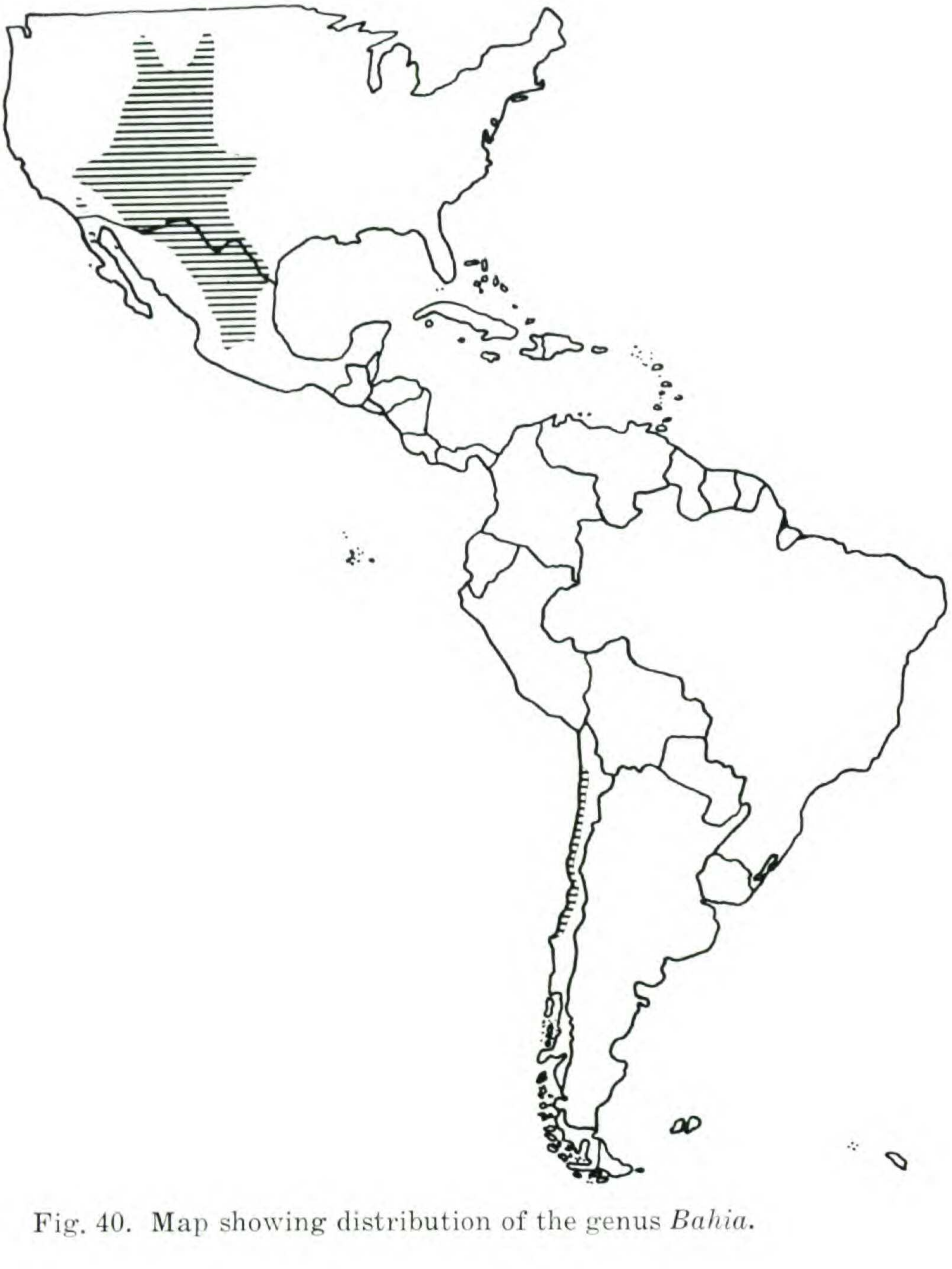

Fig. 40. Map showing distribution of the genus *Bahia*.

habitats at high elevations. Within this series, however, there is a trend toward xerophytism at lower elevations as demonstrated by *B. autumnalis.* Species of the series Oppositifoliae occur in both mesic and xeric habitats. *Bahia oppositifolia* and *B. woodhousei* are closely related perennial, grassland species which are widely distributed from Montana to central New Mexico. Whereas both annual and perennial species of western Texas and central Mexico occur in more localized mesic habitats, obviously closely related taxa show increased adaptation to more xeric conditions at lower elevations. Of the two xerophilous species of series Oppositifoliae, *B. absinthifolia* and *B. schaffneri*, the former is widespread, occurring from western Texas to southcentral Mexico while the latter is restricted to a small area in central Mexico. With the exception of but two taxa, *B. bigelovii* and *B. dissecta,* all species of *Bahia* occur in open, sunny habitats. Edaphically, the species of *Bahia* are most prevalently found in calcareous soils, although they are commonly encountered in sandy loams of igneous derivation. Some of the taxa are frequently found in more than one soil type. More specific ecological observations are given under the various species in the taxonomic section.

PHYLOGENETIC SPECULATIONS

There are many individuals who disdain phylogenetic speculations which are not founded upon paleobotanical evidence. I am of the opinion, however, that such speculations are worthwhile in that they stimulate further thought and focus attention on problems of relationship that might not be evident from a more standard treatment.

In order to present a plausible evolutionary history of a genus, the reconstruction of a probable ancestral stock is expedient, if not necessary. Small (1919) and Cronquist (1955), among others, have offered various primitive characters for the family Compositae. I shall make no attempt in the present study to defend the logic of the primitiveness of the various characters as hypothesized below. The interested reader is referred to the aforementioned papers of Small and Cronquist. If one applies the ideas propounded by them, in addition to chromosomal information, to the genus *Bahia*, the following contrasted list of primitive versus advanced characters may be obtained:

1. Chromosome number of $n = 8$ as opposed to numbers of a higher order;
2. Perennial as opposed to biennial or annual habit;
3. Herbaceous as opposed to woody stems;
4. Many-flowered as opposed to few-flowered heads;
5. Yellow as opposed to white ray flowers;
6. Pubescent as opposed to glabrous achenes;
7. Pappose as opposed to epappose achenes;
8. Entire as opposed to dissected leaves;
9. Opposite as opposed to alternate leaves;
10. Numerous as opposed to few ray flowers.

In the series Alternifoliae, 4 to 6 of the primitive attributes are found in each taxon. Six to 8 of these attributes are found in the various taxa of the series Oppositifoliae with *B. absinthifolia*, *B. pringlei*, *B. woodhousei* and *B. xylopoda* each having 8 of them. Thus, no single extant species can be considered as *the* primitive taxon. It seems probable that all of the phylads are of long standing, probably having been derived from a mesophytic progenitor.

Hypothetical natural relationships in *Bahia*, based principally upon comparative morphology, chromosome numbers, and chromatographic data, are shown in Fig. 41. Within any one series, the gaps between the taxa indicate relative divergence.

SPECIFIC CONCEPTS

An attempt has been made to delimit the natural units of *Bahia* by combining all available morphological, cytological, biochemical and ecological information. The term *species* is used for those natural entities which can be recognized readily and delimited adequately on the basis of this information. Under this concept a species is a systematic category comprising 1 or more individuals which, on a populational basis, fall within relatively discrete units, the parameters of which can be adequately circumscribed by both qualitative and quantitative features. Varietal status has been accorded those natural populations demonstrating a total similarity greater than that found at the inter-specific level, but which

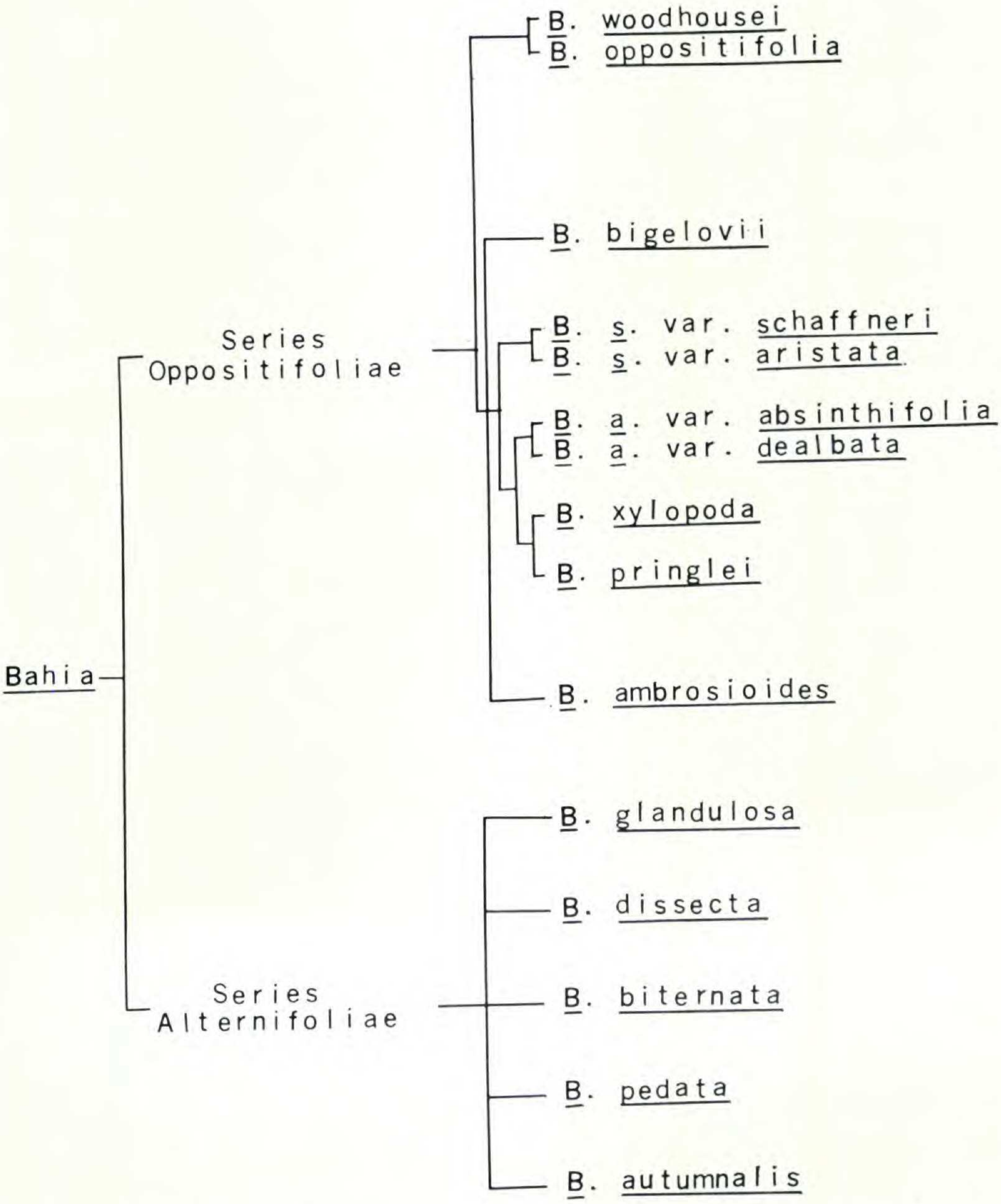

Fig. 41. Hypothetical relationships in *Bahia.* Gaps between taxa indicate relative divergence (additional explanation in text).

are recognizable by one to few characters and often only on a statistical basis. These populations are geographically coherent but often intergrade with peripheral related taxa. Thus, the recognition of varieties in the present treatment is comparable to that of the subspecies of many workers and is determined largely by relative differences and/or similarities among the taxa treated. Throughout this study there has been a concerted attempt to maintain a conservative approach and to treat the various taxa consistently with respect to their recognition as species or variety.

ACKNOWLEDGEMENTS

The author is particularly indebted to Dr. B. L. Turner for his suggestion of the problem and his untiring guidance and interest. Equivalent thanks are due my wife for her active cooperation. Appreciation is likewise expressed to Dr. R. E. Alston for his critical appraisal of the chromatographic work; to Mr. Geza Knipfer, Mrs. Karin Douthit, Mr. Paul Sun and Mr. Alexandri Garcia for various services rendered; to Drs. M. C. Johnston and Bill Cumbie for plant and bud collections; and to Drs. Lincoln Constance and W. V. Brown for critical reading of the manuscript.

A list of herbaria consulted in this study follows. The abbreviations used in the citations of the specimens are those recommended by Lanjouw and Stafleu (1956). Grateful acknowledgment is made to the curators of the herbaria for the loan of the specimens.

ARIZ University of Arizona; CAS California Academy of Sciences; DS Dudley Herbarium, Stanford University; F Chicago Natural History Museum; GH Gray Herbarium, Harvard University; LL Lundell Herbarium, Texas Research Foundation; MICH University of Michigan; PH Academy of Natural Sciences, Philadelphia; TEX University of Texas; UC University of California, Berkeley; US United States National Herbarium.

SYSTEMATIC TREATMENT

Bahia Lag., Gen. et Sp. Nov. 30, 1816.

Stylesia Nutt., Trans. Am. Phil. Soc., Ser. II, 7:377. 1841. Type species: *Bahia ambrosioides* Lag. (Nuttall proposed the generic name

Stylesia for the South American elements and, contrary to the present Code, took up the name *Bahia* for the North American taxa.)

Virletia Schultz-Bip. ex Benth. & Hook., Gen. Pl. 2:403. 1873. (In synonymy).

Picradeniopsis Rydb., in Britton Man. 1008. 1901. Type species: *Trichophyllum oppositifolium* Nutt.

Amauriopsis Rydb., N. Am. Fl. 34:37. 1914. Type species: *Amauria? dissecta* Gray.

Annual, biennial and perennial herbs or undershrubs. Stems herbaceous, erect to decumbent, slender or stout from a taproot (annual and biennial species), or herbaceous to suffruticose, erect and usually highly branched from a woody ramifying rootstock (perennial herbs and undershrubs). Leaves opposite or alternate, mostly ternately dissected into linear or ovate segments (often simple or merely lobed in *B. absinthifolia*), impressed-punctate or puncticulate with a globular exudate. Inflorescence a few- to many-headed cymose panicle. Heads radiate, hemispheric to campanulate on short or elongated slender peduncles. Involucre of 8-24 subequal bracts in 1-3 series, these membranous on the margins, usually reflexing with age. Receptacle naked, flat to slightly convex. Ray florets 5-20, pistillate and fertile with yellow or white ligules. Disc florets 25-140 with regular corollas (often zygomorphic, particularly in peripheral florets), yellow; tube glandular; throat funnelform or broadly campanulate after anthesis; lobes mostly equal, more or less reflexed after anthesis; anthers partially exserted in mature florets, inconspicuously sagittate at the base with an ovate terminal appendage; style branches more or less flattened with stigmatic lines marginal on the inner upper surface, apices obtuse with papillose enlargements, more or less recurved at maturity; achenes 4-sided, narrowly obpyramidal, hispid, glandular or glabrous; pappus of 8-15 scarious obovate or lanceolate scales thickened at the base with the midrib lacking, percurrent or excurrent.

Basic chromosome numbers as determined from meiotic counts on ten of the taxa, $x = 8, 10, 11, 12, 18$ (with tetraploids in the 11 and 12 series plus a hexaploid in the 12 series).

ARTIFICIAL KEY TO TAXA

1. Leaves alternate (opposite or nearly so only at the very base); plants 30-120 cm. tall, the stems single and erect from a root-crown (occasionally 2-3 through injury), 4-15 mm. in diameter. .... Series ALTERNIFOLIAE
  2. Ray florets white or pale yellowish-cream; achenes markedly hispid at base, glabrous or nearly so above; vegetative parts (including involucral bracts) markedly stipitate-glandular. .... 1. *B. glandulosa*
  2. Ray florets yellow; achenes either glabrous or hispid on all parts (except in *B. autumnalis*); vegetative parts with or without stipitate glands, but when present not on all parts (except in *B. pedata*).
    3. Pappus absent or rarely present (when present, the scales distinctly lanceolate); achenes glabrous or inconspicuously hispidulous (sparingly hispidulous when a pappus is present). .... 2. *B. dissecta*
    3. Pappus present, the scales oblanceolate, obovate or spatulate (rarely lanceolate); achenes distinctly hispid.
      4. Achenes glabrous on the sides; vegetative parts without stipitate glands; Nuevo León and extreme eastern Coahuila. .... 3. *B. autumnalis*
      4. Achenes hispidulous on all parts; vegetative parts with stipitate glands; New Mexico, Arizona, Chihuahua, and northwestern Coahuila.
        5. Pappus scales of inner achenes with a prominent excurrent midrib; leaf segments 1-3 mm. wide; stipitate glands mostly restricted to upper stem. .... 4. *B. biternata*
        5. Pappus scales mostly lacking an excurrent midrib (when excurrent, minutely so and throughout the head); leaf segments 2-5 mm. wide; stipitate glands present on all vegetative parts. .... 5. *B. pedata*
1. Leaves opposite (becoming alternate on upper branches only); plants 5-25 (-100) cm. tall, the stems branched from the base (single and erect in *B. bigelovii*), 1-7 mm. in diameter. .... Series OPPOSITIFOLIAE
  6. Suffruticose; ray florets white or cream-colored; South America. .... 6. *B. ambrosioides*
  6. Herbaceous or suffrutescent; ray florets yellow; North America.
    7. Plants annual.
      8. Stems erect; mountains of western Texas. .... 7. *B. bigelovii*
      8. Stems decumbent; plateau of north-central Mexico.
        9. Pappus scales without midribs, 0.7-1.5 mm. long. .... 8a. *B. schaffneri* var. *schaffneri*
        9. Pappus scales with distinct midribs extending as excur-

rent awns, 1.2-2 mm. long (excluding awn). ....
.... 8b. *B. schaffneri* var. *aristata*

7. Plants perennial.
    10. Upper leaves opposite; ray florets 4-9, the ligules 2-4(6) mm. long; disc florets 25-40.
        11. Achenes glandular; pappus scales ovate or obovate (rarely lanceolate with percurrent or excurrent midribs). .... 9. *B. oppositifolia*
        11. Achenes hispidulous; pappus scales lanceolate with percurrent or excurrent midribs. ...... 10. *B. woodhousei*
    10. Upper leaves alternate; ray florets 9-15; the ligules 4-9 (-15) mm. long; disc florets 60-120.
        12. Leaves densely white pubescent; pappus scales 6-9; lateral roots not forming adventitious shoots; southwestern United States to central Mexico.
            13. Leaves commonly trifid or dissected, the leaf segments 1-3 mm. wide. ....
            .... 11a. *B. absinthifolia* var. *absinthifolia*
            13. Leaves commonly entire, toothed or trifid, the leaf segments (1-) 2-15 mm. wide. ....
            .... 11b. *B. absinthifolia* var. *dealbata*
        12. Leaves sparsely pubescent; pappus scales 8; lateral roots forming adventitious shoots; Hidalgo.
            14. Pappus scale width/length ratio = 0.5-0.7; rootstock 2-5(15) mm. thick; chromosome number, n = 11. .... 12. *B. xylopoda*
            14. Pappus scale width/length ratio = 0.75-1.2; rootstock 2-4(8) mm. thick; chromosome number, n = 22. .... 13. *B. pringlei*

Series ALTERNIFOLIAE

1. *Bahia glandulosa* Greenman

Bahia glandulosa Greenman, Proc. Am. Acad. 39:116. 1904. Holotype examined (GH): "Durango and vicinity," Durango, Mexico, April to November, 1896, *E. Palmer 492*. The type collection [the holotype can be only one sheet] is represented by two sheets. Isotypes examined: (F, UC, US).

Hymenopappus glandulopubescens Waterfall, Rhodora 59:97. 1957. Isotype examined (GH): "Grassy flat, 11 miles west of Durango, Durango, Mexico," August 10, 1956, *U. T. Waterfall 12576*. (Holotype: OKLA, not examined).

Plants annual (biennial?), 60-120(-150) cm. tall. Stem single and erect from a tap root (rarely 2 or more stems forming from the rootcrown following injury), 4-8 mm. in diameter, paniculately branched, each terminal branch culminating in 1-7 monocephalic peduncles, ribbed, variously pubescent and with numerous stipitate glands, the latter up to 0.8 mm. long; peduncles 1-7 cm. long, sparsely to densely pubescent and stipitate-glandular. Leaves opposite or nearly so at the extreme base, otherwise alternate, ternately divided, each segment compoundly subdivided into linear or narrowly oblanceolate segments 1-4 mm. wide, upper leaves ternately divided into linear entire segments, 3-14 cm. long, pubescent, blade puncticulate with globules of exudate in the depressions and few to numerous stipitate glands, petiole with numerous stipitate glands. Mature heads (including florets) 4-8 mm. high, 10-17 mm. in diameter. Involucre broadly campanulate; involucral bracts stipitate-glandular, 12-17 in 1-2 series, frequently with 1-2 outer bractlets, reflexing with age, membranous margins occasionally tinged with purple, 3-4.5 mm. long, 1.2-2 mm. wide, obovate or lanceolate, apex obtuse or somewhat acuminate, midrib weakly discernible or absent. Receptacle somewhat convex, alveolate, 2.8-3.2 mm. in diameter. Ray florets 10-25, white or very pale yellowish-cream, pistillate, fertile; ligule 3-6(8) mm. long, 3.5-4.5 mm. wide, obovate with truncate undulate apex; tube 0.2-0.3 mm. in diameter, 1.5-2 mm. long with few to numerous stipitate glands (occasionally almost glabrate). Disc florets 100-140, perfect and fertile, yellow, regular, 2.7-3.3 mm. long; tube and lower throat with few to numerous stipitate glands; tube 0.3-0.4 mm. in diameter, 1.2-1.5 mm. long; throat broadly campanulate, 0.7-1.3 mm. long; lobes 5, reflexed at maturity, 0.4-0.8 mm. long; anthers 1-1.3 mm. long, partially exserted at maturity; style branches flattened, 0.6-0.8 mm. long with prominent stigmatic lines along the upper margins, reflexed at maturity, apices obtuse with reduced papillose enlargements; achenes 2-3.8 mm. long, narrowly obpyramidal, 4-sided, dark brown or black, hispid on the angles near the base, the hairs to 0.3 mm. long, glabrous or nearly so on the upper part; pappus of 11-12 scarious obovate-lanceolate scales, 0.5-1 mm. long, 0.2-0.5 mm. wide, thickened at the base with the midrib extending about ½ of the length of the scale. Chromosome number, $n = 12$.

DISTRIBUTION: Clayey or sandy soil of igneous derivation in the states of Aguascalientes, Zacatecas and Durango, Mexico, 6000-7500 ft. (Fig. 42). Principal flowering dates August-October.

B. glandulosa is the only North American taxon of the genus which has white rays. Whereas this could indicate a close affinity to *B. ambrosioides* of South America, which also has white rays, in total morphology *B. glandulosa* is more closely allied to the other four species in the series Alternifoliae than to any other taxon or group of taxa in the genus.

There has been some confusion between *B. glandulosa* and *B. pedata* in a possible region of overlap near the Chihuahua-

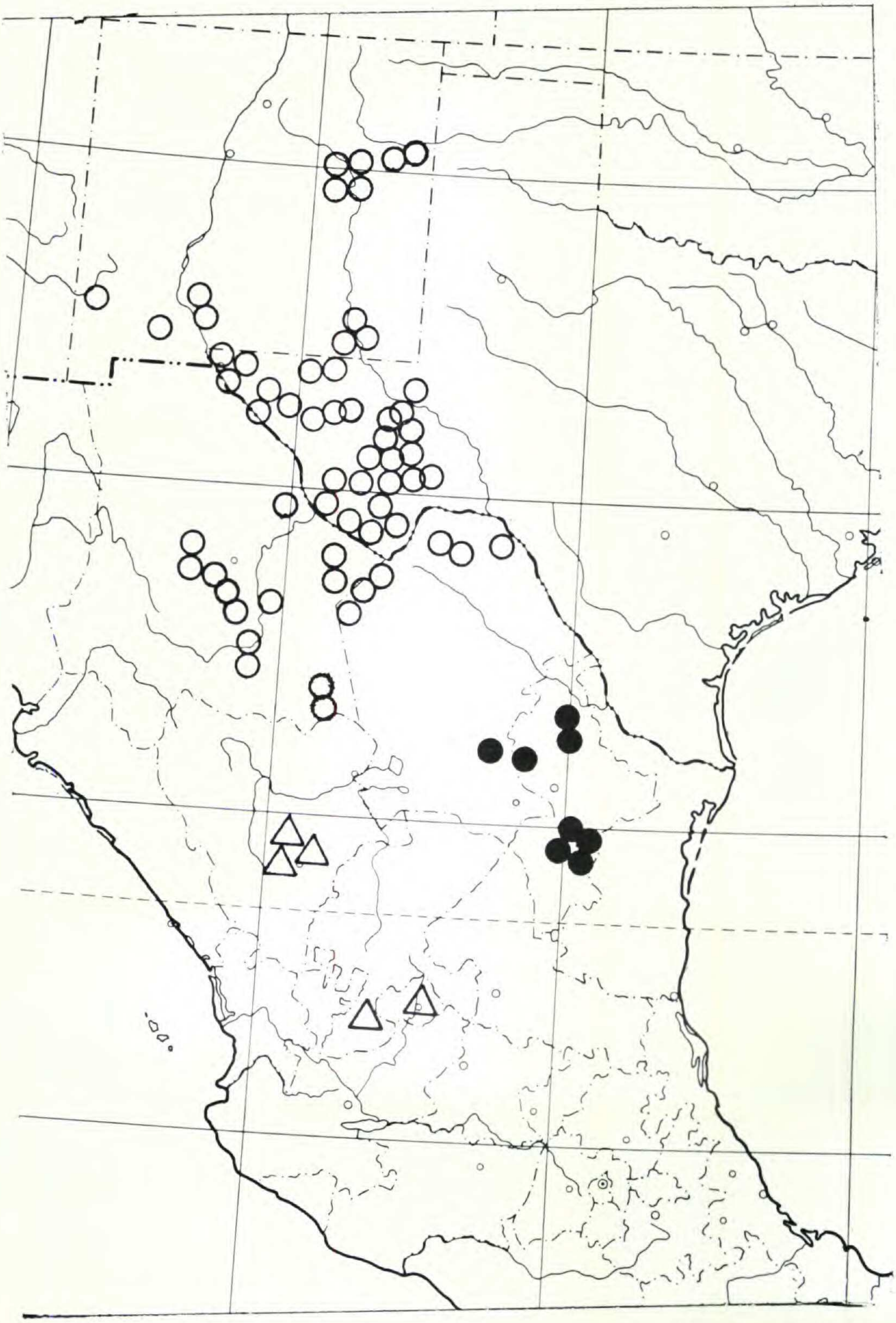

Fig. 42. Map showing distribution of *B. autumnalis*, closed circle; *B. glandulosa*, open triangles; *B. pedata*, open circles.

Durango line. Greenman misidentified plants of *B. pedata* as *B. glandulosa*, these having been collected near Chihuahua *(C. G. Pringle 308*, labeled as *B. biternata)*; on the basis of glandulosity and leaf shape the specimens of this collection do bear a superficial resemblance to *B. glandulosa*, but on the basis of total morphology they are properly assigned to *B. pedata*. Field observations of populations of *B. pedata* made by the writer in the vicinity of Parral and Chihuahua, Chihuahua, and northward indicated that only robust yellow-rayed plants referable to *B. pedata* occupied this region. However, the individuals were somewhat more viscid and definitely had more dissected leaves than did those of *B. pedata* at more northerly latitudes. The possibility of hybridization and resultant introgression between the latter taxon and *B. glandulosa* cannot be dismissed. A more intensive populational and cytological study needs to be conducted in order to ascertain the nature of this variation.

SPECIMENS EXAMINED: MEXICO. AGUASCALIENTES: Near Aguascalientes, Oct. 9, 1903, *J. N. Rose & J. H. Painter 7759* (US). DURANGO: 11 miles W. of Durango on Hwy. 40, 7400 ft., Sept. 3, 1960, *W. L. Ellison & A. Garcia 118* (TEX). 23 miles N. of Durango on Hwy. 45, 6300 ft., Sept. 3, 1960, *W. L. Ellison & A. Garcia 125* (TEX). 15 miles S. W. of Durango on Hwy. 40, Aug. 16, 1960, *R. M. King 3737* (TEX). Durango and vicinity, Apr.-Nov., 1896, *E. Palmer 492* (F, GH, UC, US). North base of Cerrito del Santuario, Durango, Oct. 15, 1910, *C. Patoni 94* (F). ZACATECAS: Near Plateado, Sept. 3, 1897, *J. N. Rose 2772* (GH, US).

2. *Bahia dissecta* (Gray) Britton

Amauria? dissecta Gray, Mem. Am. Acad. II. 4:104. 1849. Holotype examined (GH): "A few miles east of Mora River," August, 1847, *A. Fendler 537*. *Villanova chrysanthemoides* Gray, Pl. Wright. 2:96. 1853. *Bahia chrysanthemoides* (Gray) Gray, Proc. Am. Acad. 19:28. 1883. *Bahia dissecta* (Gray) Britt., Trans. N. Y. Acad. Sci. 8:68. 1888. *Eriophyllum chrysanthemoides* (Gray) Kuntze, Rev. Gen. Pl. 337. 1891. *Villanova dissecta* (Gray) Rydb., Bull. Torr. Club 37:333. 1910. *Amauriopsis dissecta* (Gray) Rydb., N. Am. Fl. 34:37. 1914.

Bahia dissecta (Gray) Britt. var. *anisopappa* Blake, Jour. Wash. Acad. Sci. 6:319. 1935. Holotype examined (US): "Sandy soil along La Sanca Creek, below La Grulla, Sierra San Pedro Martir, alt. 2040 m.," Sept. 17, 1930, *I. L. Wiggins & D. Demaree 4870*. Isotypes examined: (DS, UC).

Plants annual (biennial?), 20-80(-120) cm. tall. Stem single and

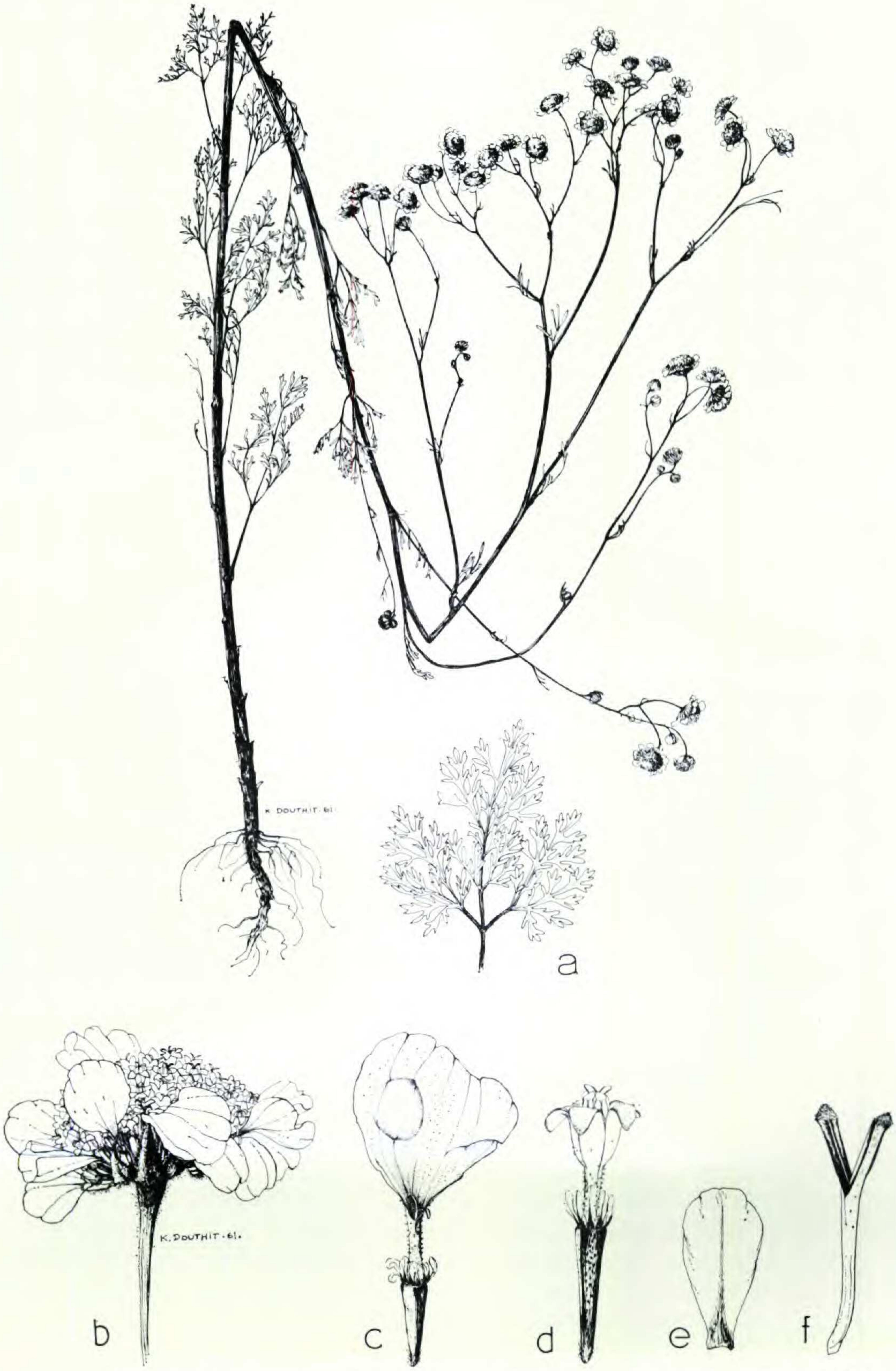

Fig. 43. *B. glandulosa* (*Rose 7759*, US). Entire plant, × 2/7. a. Midstem leaf, × ca. 2/7. b. Head, × ca. 2. c. Ray floret, × ca. 4. d. Disc floret, × ca. 4. e. Pappus scale, × ca. 18. f. Style branches, × ca. 12.

erect from a taproot (rarely 2-3 stems forming from the root-crown following injury), 2-7 mm. in diameter, paniculately branched, each terminal branch culminating in numerous monocephalic peduncles, ribbed, usually reddish-purple, except the upper branches, farinose, more or less pubescent with numerous stipitate glands on the upper stems and peduncles (rarely peduncles almost tomentose and non-glandular). Leaves commonly in a close spiral arrangement on the lower stem, alternate, ternately divided, each segment compoundly subdivided into linear or oblong-ovate segments 1-3 mm. wide, upper leaves reduced in size and ternately divided into entire linear-lanceolate segments, 2-13 cm. long, more or less pubescent, occasionally farinose (rarely with globules of exudate). Mature heads (including florets) 5-10 mm. high, 10-20 mm. in diameter. Involucre hemispheric or broadly campanulate; involucral bracts pubescent and/or with few to numerous stipitate glands (rarely nearly glabrous), often farinose, globules of exudate numerous or absent, 12-24 in 2-3 series, partially reflexing with age, green or somewhat purplish with membranous margins, 4.5-6 mm. long, 1-3 mm. wide, oblanceolate to lanceolate, apex markedly acuminate, midrib weakly discernible or absent. Receptacle somewhat convex, alveolate, 2-3 mm. in diameter. Ray florets 10-20, yellow, pistillate, fertile; ligule 5-7.5 mm. long, 2-3.5 mm. wide (rarely strongly reduced and/or highly modified; Fig. 46), linear-oblong with apex notched or irregularly lobed; tube 0.3-0.5 mm. in diameter, 1.5-2.5 mm. long with numerous stipitate glands. Disc florets 50-100, perfect and fertile (occasionally pistillate), yellow, regular or distinctly zygomorphic, 2.5-3.5(4.5) mm. long; tube, throat and lobes with numerous stipitate glands; tube 0.3-0.5 mm. in diameter, 1-1.5 mm. long; throat narrowly campanulate or funnelform, (0.4)1-1.5 mm. long; lobes 5, partially reflexed at maturity, 0.3-1(2) mm. long, rarely equal to or longer than the combined tube and throat; anthers 1.6-2 mm. long, only slightly exserted at maturity; style branches flattened, 1-1.5 mm. long with prominent stigmatic lines along the upper margins, reflexed at maturity, apices obtuse with a papillose enlargement; achenes 3-4.5 (5) mm. long, narrowly obpyramidal, 4-sided, dark brown or black, hispidulous or nearly glabrous; pappus usually lacking (when present, pappus scales lanceolate, 1-13 in number, 1.5-3(5) mm. long, 0.2-0.4 mm. wide, thickened at the base with the midrib percurrent or excurrent). Chromosome number, $n = 18$.

DISTRIBUTION: Igneous, granitic and sandy alluvial soils in juniper-pine woodlands in mountainous regions of west Texas, New Mexico, Arizona, southern California, Nevada, Wyoming, Colorado, and in northern Baja California, northern Sonora and Chihuahua, Mexico, 5200-9300 ft., (Fig. 44). Principal flowering dates July-October.

Blake described *B. dissecta* var. *anisopappa*, a pappose

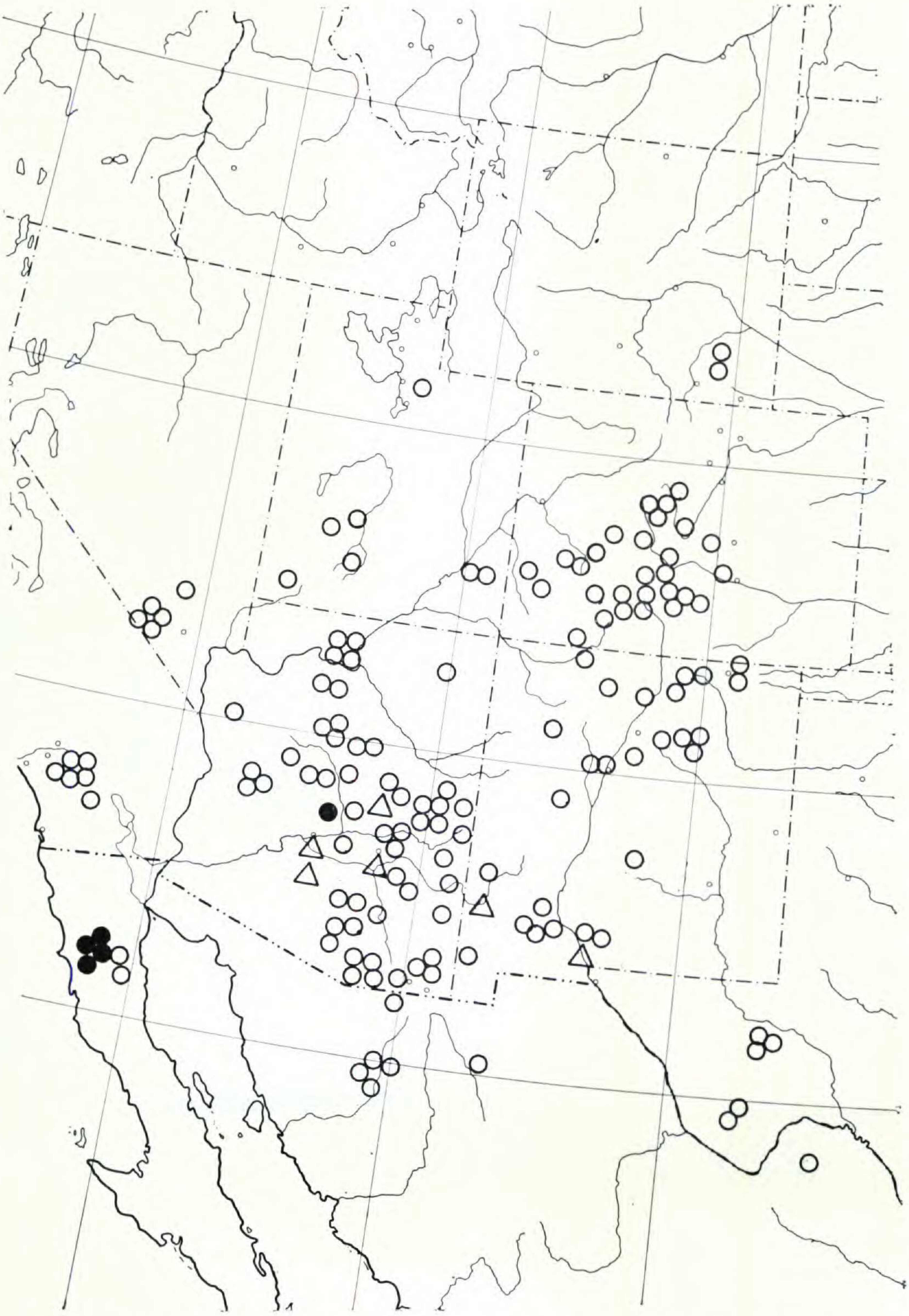

Fig. 44. Map showing distribution of *B. biternata*, open triangles; *B. dissecta*, w/o pappus scales, open circles; *B. dissecta* with pappus scales, closed circles.

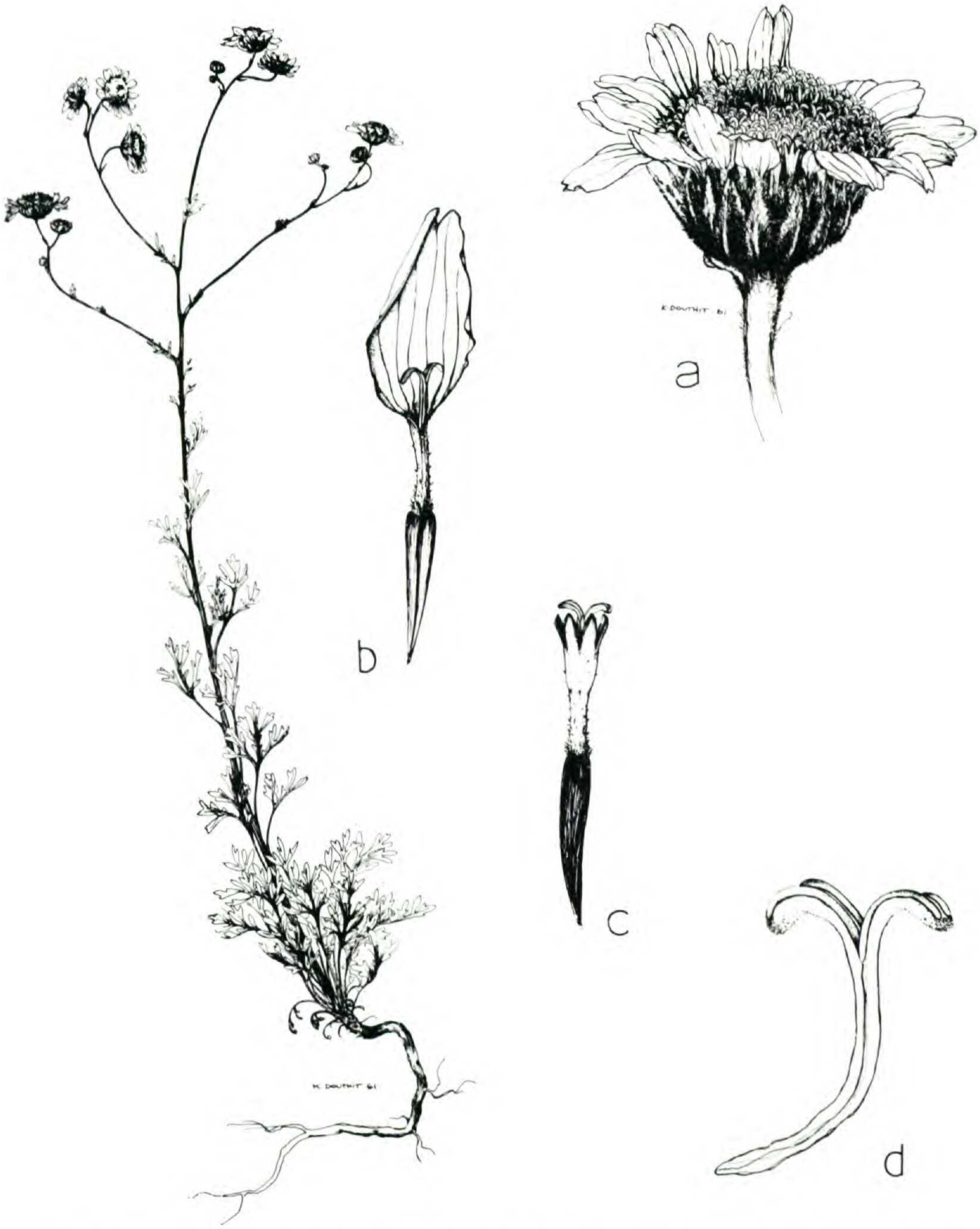

Fig. 45. *B. dissecta* (Holotype, *Fendler 537*, GH). Entire plant, × 2/7. a. Head, × ca. 2. b. Ray floret, × ca. 4. c. Disc floret, × ca. 4. d. Style branches, × ca. 12.

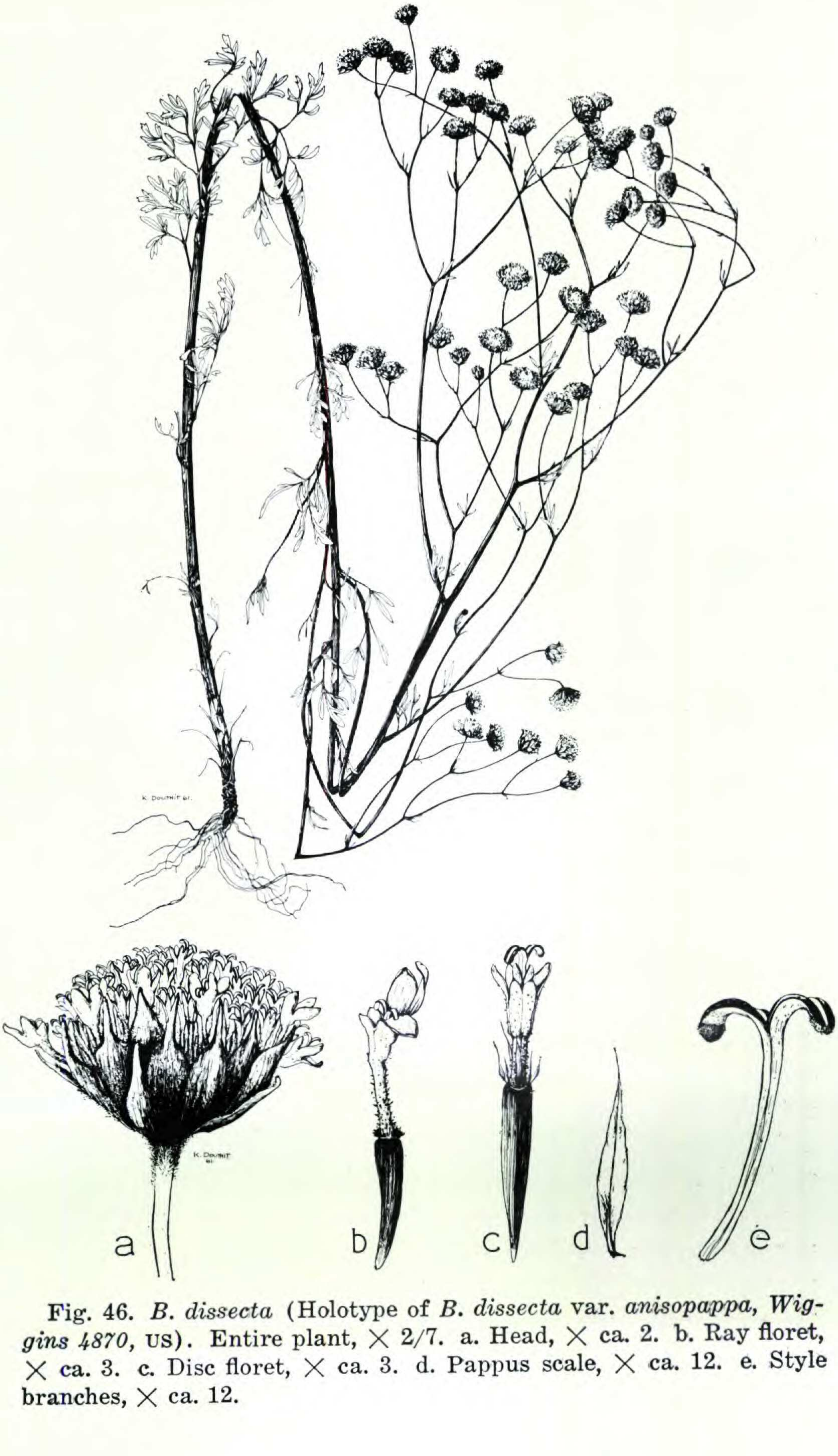

Fig. 46. *B. dissecta* (Holotype of *B. dissecta* var. *anisopappa*, *Wiggins 4870*, US). Entire plant, × 2/7. a. Head, × ca. 2. b. Ray floret, × ca. 3. c. Disc floret, × ca. 3. d. Pappus scale, × ca. 12. e. Style branches, × ca. 12.

form of *B. dissecta*, as "indistinguishable from typical *B. dissecta* except by its imperfectly and perhaps abnormally disciform heads and more definitely hispidulous achenes." The disciform heads are associated with the pappose form, but pappose forms exist which have normally developed ray florets *(McDougal 701, Wiggins 4886, Wiggins 9081)*. Both pappose and epappose forms are found in Baja California, and these, presumably, in discrete populations. There are apparently no geographical or ecological factors involved in their separation. The pappose condition is variable; that is, there may be no or one or more scales up to a maximum of about 13. This variation may occur to some degree within an individual head or between individuals of a population, as well as between populations. Two specimens of the pappose form were found in localities other than Baja California; namely, one from Pine, Arizona *(McDougal 701)*, the other from Hurrah Creek, New Mexico(?) *(Bigelow s. n.)*.

It is probable that Blake's observation that the presence of "better developed hairs on the achenes of var. *anisopappa* is no doubt correlated here . . . with the development of a pappus" is sound. It has been determined that a single gene may control the presence and absence of both pappus and hairs on an achene (Clausen, 1951). Though this may not apply to *B. dissecta* on any *a priori* basis, it does seem probable that the pappose condition of this species may be influenced by no more than a few genes. Their random segregation would account for the occasional occurrence of the pappose condition in geographically isolated populations. A gene pool favoring the pappose form is presumably present in Baja California. Whereas future populational and cytological studies may indicate a reinstatement of var. *anisopappa*, I think its submergence into *B. dissecta* proper on the basis of total evidence at this time.

In Gray's original description of *Amauria? dissecta*, he indicated that "the stamens are abortive in all the disc flowers." Pistillate disc florets were found in about 5% of the specimens examined. There was no apparent geographical or ecological factor associated with this condition.

Blake makes a point of his having found no specimens fulfilling Gray's description of the lobes of the disc corollas "almost equalling the tube and throat together." Though this condition of elongate lobes is not commonplace, neither is it extremely rare.

REPRESENTATIVE COLLECTIONS: ARIZONA. APACHE CO.: Near Greenlee Co. line on road from Hwy. 260 to Blue, 7900 ft., Sept. 4, 1948, *F. W. Gould & M. E. Robinson 5135* (ARIZ, UC). COCHISE CO.: Chiricahua Nat'l. Forest, Paradise, 2200 m., Sept. 23, 1914, *W. W. Eggleston 10861* (GH, US). COCONINO CO.: Flagstaff, Aug. 29, 1884, *M. E. Jones 4100* (ARIZ, CAS, DS, F, US). Pine Creek, Pine, Aug. 26, 1891, *D. T. McDougal 701* (US). GILA CO.: Sierra Ancha Mts., Workman Creek area, Peterson Ranch, 7000 ft., Aug. 31, 1946, *F. W. Gould & R. K. Hudson 3769* (ARIZ, GH, UC). GRAHAM CO.: Pinaleno Mts., Hospital Flats, 8500 ft., Sept. 4, 1944, *R. A. Darrow, W. S. Phillips & L. M. Pultz 1165* (CAS, DS, LL). GREENLEE CO.: 45 miles N. of Clifton, White Mts., 8100 ft., Aug. 11, 1935, *T. H. Kearney & R. H. Peebles 12254* (ARIZ, GH). MOHAVE CO.: Hualpai Mt., 5100 ft., Sept. 19, 1935, *T. H. Kearney & R. H. Peebles 12666* (ARIZ). NAVAJO CO.: Black Mesa, Sept. 13, 1938, *A. Eastwood & J. T. Howell 6627* (CAS). PIMA CO.: Rincon Mts., 7400 ft., Sept. 9, 1909, *J. C. Blumer 3595* (ARIZ, DS, F, GH). SANTA CRUZ CO.: Santa Rita Mts., 6000 ft., Sept. 30, 1944, *F. W. Gould 2629* (ARIZ, UC). YAVAPAI CO.: Near Prescott, Nov. 11, 1928, *A. Eastwood 16824* (CAS). CALIFORNIA. RIVERSIDE CO.: Santa Rosa Mts., ridge E. of Toro Peak, 8000 ft., Aug. 14, 1938, *P. A. Munz 15364* (CAS). SAN BERNARDINO CO.: San Bernardino Mts., Santa Ana River, 6600 ft., Aug. 21, 1922, *P. A. Munz 6130* (CAS, DS, UC). COLORADO. ARAPAHOE CO.: Denver, along Platte R., 5200 ft., Aug. 27, 1918, *I. W. Clokey 3246* (CAS, DS, TEX). ARCHULETA CO.: 5 miles W. of Pagosa Springs, Aug. 10, 1937, *M. Ownbey 1429* (UC). BOULDER CO.: 0.5 miles below Jamestown, above Boulder, 7500 ft., July 14, 1941, *J. A. Ewan 13345* (CAS, GH). CLEAR CREEK CO.: Near Empire, 9000 ft., Aug. & Sept., 1892, *H. N. Patterson 223* (F, GH, MICH, US). CONEJOS CO.: 0.5 miles S. of Rito Hondo Creek, 2 miles S. W. of Bighorn Corral, 8500 ft., Aug. 3, 1936, *R. C. Rollins 1482* (GH). CUSTER CO.: 1 mile above Rosita, 9000 ft., Sept. 4, 1943, *J. Ewan 15385* (DS). DOUGLAS CO.: 4.5 miles S. E. of Deckers, Aug. 17, 1941, *U. T. Waterfall 3476* (GH). EL PASO CO.: Black Forest near Colorado Springs, Aug. 22, 1939, *J. H. Ehlers 7876* (ARIZ, MICH). FREMONT CO.: 4 miles E. of Texas Creek, canyon of Arkansas River, Aug. 31, 1924, *R. Bacigalupi 1018* (DS, GH). JEFFERSON CO.: Buffalo Creek, Sept. 9, 1940, *H. L. Zobel s.n.* (TEX). LAKE CO.: Lake Creek, 9600 ft., Aug. 11, 1919, *I. W. Clokey 3482* (CAS, DS, F, GH). LARIMER CO.: Estes Park, 8000 ft., Aug. 14, 1904, *W. S. Cooper s.n.* (ARIZ). LAS ANIMAS CO.: Stonewall, Aug., 1917, *F. Beckwith 234* (DS).

MESA CO.: Uncompahgre Plateau, about 25 miles S. W. of Whitewater, 7500 ft., Aug. 12, 1937, *R. C. Rollins 1924* (DS). MINERAL CO.: Station A-2, Wagon Wheel Gap Experimental Station, 9600 ft., Aug. 6, 1911, *J. Murdoch, Jr. 4817* (F). MONTROSE CO.: Near 25 Mesa Ranger Station, T. 494, R. 13W., Uncompahgre National Forest, Aug. 30, 1947, *W. A. Weber 3541* (DS, TEX,UC). PARK CO.: Como, Leadville Forest, 2960 m., Sept. 14-15, 1915, *W. W. Eggleston 11983* (US). SAGUACHE CO.: 6 miles E. of Marshall Pass, Aug. 26, 1910, *I. Tidestrom 4084* (US). SAN MIGUEL CO.: Norwood Hill, 7000 ft., Aug. 10, 1912, *E. P. Walker 421* (DS, GH, US). TELLER CO.: North of Florissant, Aug. 27, 1939, *J. H. Ehlers 7915* (MICH). NEW MEXICO. BERNALILLO CO.: Sandia Mts., N. E. of Albuquerque, Aug. 23, 1926, *W. Koelz s.n.* (MICH). CATRON CO.: Mogollon Mts., near West Fork of Gila River, 7500 ft., Aug. 25, 1903, *O. B. Metcalfe 602* (ARIZ, US). COLFAX CO.: Vermejo Park, July & Aug., 1894, *Mrs. O. St. John 169* (GH, LL). DONA ANA CO.: Organ Mts., Aug., 1881, *G. R. Vasey s.n.* (F, US). GRANT CO.: Fort Bayard watershed, Aug. 20, 1905, *J. C. Blumer 221* (GH, US). HIDALGO CO.: Animas Valley, Oct. 2, 1893, *E. A. Mearns 2497* (US). LINCOLN CO.: White Mts., 7400 ft., Aug. 25, 1907, *E. O. Wooton & P. Standley 3678* (DS, MICH, US). RIO ARRIBA CO.: Near Dulce, Jicarillo Apache Indian Res., 2150-2470 m., Aug. 20, 1911, *P. C. Standley 8227* (US). SAN JUAN CO.: Tunitcha Mts., Navajo Indian Res., Aug. 8, 1911, *P. C. Standley 7612* (US). SAN MIGUEL CO.: Las Vegas, Dec. 10, 1927, *Arsene 19359* (CAS, GH). SANTA FE CO.: Santa Fe Canyon, 2500 m., July 31, 1926, *Arsene & Benedict 16906* (CAS, DS). SIERRA CO.: Kingston, 6800 ft., Sept. 14, 1904, *O. B. Metcalfe 1345* (CAS, F, GH, US). SOCORRO CO.: Magdalena Mts., Hop Canyon, Aug. 27, 1895, *C. L. Herrick 6262* (US). TAOS CO.: Taos Canyon, Sept. 8, 1929, *E. Whitehouse s.n.* (TEX). VALENCIA CO.: Mt. Taylor, 20 miles N. E. of Grants, 8250 ft., Aug. 30, 1933, *K. F. Parker 1911* (ARIZ). NEVADA. CLARK CO.: Fletcher Canyon, 2700 m., Aug. 26, 1939, *I. W. Clokey & A. Anderson 8572* (ARIZ, CAS, DS, F, GH, TEX, UC). LINCOLN CO.: Fay, 4 miles E. of Deer Lodge, Sept. 20, 1938, *P. Train 2543* (DS, UC). TEXAS. BREWSTER CO.: Chisos Mts., Aug. 15, 1931, *C. H. Mueller 8239* (CAS, GH, MICH, TEX, US). JEFF DAVIS CO.: Madeira Canyon, Scenic Loop Road, 21 miles from Ft. Davis, 6000 ft., Sept. 11, 1959, *W. L. Ellison & B. L. Turner 22* (TEX). UTAH. BEAVER CO.: Fillmore Nat'l. Forest, headwaters of Beaver Creek, Tushar Ranger Station, 2800 m., Aug. 8-9, 1914, *W. W. Eggleston 10444* (US). GARFIELD CO.: Sevier Forest, Panguitch Creek, Bunker Creek, 2700 m., Sept. 19, 1918, *W. W. Eggleston 14935* (GH). PIUTE CO.: Near Marysvale, Fate Mine, 9000 ft., Aug. 22, 1894, *M. E. Jones 5850* (F, US). SAN JUAN CO.: E. of Abajo Mts., Sept. 15, 1938, *A. Eastwood & J. T. Howell 6754* (CAS). WASATCH CO.: Wasatch Mts., Lake Blanche, Aug. 17, 1911, *Mrs. J. Clemens s.n.* (CAS). WASHINGTON CO.: Pine Valley, Aug. 20, 1918, *E. M. Hall 555* (US). WYOMING. ALBANY CO.: Laramie Peak, Aug. 7, 1895, *A. Nelson 1634* (GH, US).

MEXICO. BAJA CALIFORNIA: La Fresa, on trail from Vallecitos to

Valle Trinidad, Sierra San Pedro Martir, 6200 ft., Sept. 23, 1938, *I. L. Wiggins 9081* (DS, GH, US). 5 miles N. of La Encantada on road to Vallecitos, Sierra San Pedro Martir, Sept. 22, 1938, *I. L. Wiggins 9070* (DS, US). Sierra San Pedro Martir, Meling's Ranch, Sept. 18, 1930, *I. L. Wiggins & D. Demaree 4886* (DS, MICH, US). Vallecitos, Sierra San Pedro Martir, 8060 ft., Sept. 21, 1930, *I. L. Wiggins & D. Demaree 4967* (DS, F, GH, MICH, UC, US). CHIHUAHUA: Between Col. Garcia and Pratt's Ranch below Pacheco, Aug. 22-24, 1899, *E. W. Nelson 6263* (GH, US). Near Col. Garcia, 7500 ft., Aug. 19, 1899, *C. H. T. Townsend & C. M. Barber 268* (GH, US). Sierra Madre, Aug. 3, 1899, *C. H. T. Townsend & C. M. Barber s.n.* (US). COAHUILA: Del Carmen Mts., Sept. 13, 1936, *E. G. Marsh, Jr. 904* (GH). SONORA: San José Mts., Oct. 6, 1892, *E. A. Mearns 1046* (US). Rancho de Cruz Diaz, Aug. 7, 1940, *E. A. Phillips 429* (GH, MICH). Sierra de El Tigre, Las Tierritas de El Temblor, Aug. 18-24, 1940, *S. S. White 3349* (ARIZ, GH, MICH). Sierra de El Tigre, Las Tierritas de El Temblor, Aug. 18-24, 1940, *S. S. White 3416* (GH, MICH). El Rancho del Roble, N. E. of El Tigre, 6000 ft., Sept. 2-13, 1941, *S. S. White 4191* (GH, MICH). El Rancho del Roble, N. E. of El Tigre, 6000 ft., Sept. 2-13, 1941, *S. S. White 4300* (ARIZ, GH, LL, MICH).

3. *Bahia autumnalis* sp. nov.[8]

Plantae annuae biennesve 30-120(-150) cm. alt. Caules e radice terete ligneo singuli erectique orientes (interdum 2 vel 3 caules principales e corona radicis divergentes), ad basim saepe amplificati, super amplificationem 3-10 mm. diam., laxe in paniculis ramosi, omnibus ramis terminalibus in 2 ad multos pedunculos monocephalicos abeuntibus; caulis costatus pubescens farinosus, paucos ad multos globulos exsudati superficiei agnatos (glandibus stipitatis elongatis raro praeditus) habens; pedunculi 5-40 mm. long., pubescentes aut tomentosi, farinosi, globulos exsudati velut in caulibus habentes, pilis glandularibus rarissimis. Folia 4-11 cm. long. plus minusve pubescentes, raro farinosa, paucos ad multos globulos exsudati in depressionibus laminae puncticulatae habentia, ad basim extremam opposita aut quasi opposita, alibi alterna, ternate divisa, omnibus segmentis in multa segmenta lineari-ovata 3-6 mm. lat. iterum divisis, folia summa in segmenta linearia integra ternate divisa. Capitulum maturum 5-10 mm. alt., 10-15 mm. diam. Involucrum late campanulatum, bracteae involucri 18-24 in 2-3 ordinibus, maturae reflexae virides, marginibus membranaceis, pubescentes, globulis exsudati saepe farinosae, 4-6 mm. long., 1-2.5 mm. lat., obovatae aut lanceolatae, apice acuminato, costa aegre evoluta aut nulla. Receptaculum alinquantulum convexum, alveolatum, 2-3 mm. diam. Flosculi radii 15-20, flavi pistillati fertiles; ligulae 4-4.5 mm. long., 1.5-3 mm. lat., oblongae, apice 3-lobato aut undulato; tubus 0.3 mm. diam., 1.3-1.6 mm. long., aliquot glandibus brevibus stipitatis c.

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[8] Grateful acknowledgment is made to Dr. Hannah T. Croasdale of Dartmouth College who prepared the Latin description.

0.1 mm. long. praeditus. Flosculi disci 90-140, perfecti fertilesque, flavi, regulares aut in peripheria satis zygomorphici, 2-3.5 mm. long.; tubus et iugulum inferius glandibus paucis ad multas brevibus stipitatis praedita; tubus 0.3 mm. diam., 0.7-1 mm. long.; iugulum campanulatum, 1-1.5 mm. long.; lobi 5, in flosculis maturis reflexi, 0.7-1.3 mm. long., ratione iuguli et lobi maxime variante, antherae 1.5-1.8 mm. long., maturae partim exsertae; rami styli complanati, 0.8-1.3 mm. long., lineas stigmaticas manifestas in marginibus superioribus habentes, maturi reflexi, apicibus obtusis amplificatione papillosa; achaenia 2.5-4 mm. long., anguste obpyramidalia quadrilateralia, brunnea ad atra, interdum striata, in angulis prope basim valde hispida, supra sparse pubescentia, lateribus glabris; pappus ex 11-12 squamis scariosis oblanceolatis, marginibus laceratis, 1-13 mm. long., 0.3-0.6 mm. lat., ad basim incrassatis, costas plus minusve evolutas habentibus, costis fere ad apices extensis, constans.

Plants annual or biennial, 30-120(-150) cm. tall. Stem single and erect from a woody taproot (occasionally 2 or 3 major stems forming from the root-crown following injury), frequently enlarged at the base, 3-10 mm. in diameter above this enlargement, loosely and paniculately branched, each terminal branch culminating in 2-numerous monocephalic peduncles, ribbed, variously pubescent and farinose with few to numerous globules of exudate adnate to the surface (rarely with elongated stipitate glands); peduncles 0.5-4 cm. long, pubescent or tomentose, farinose, globules of exudate as on the stem, almost never with stipitate glands. Leaves opposite or nearly so at the extreme base, otherwise alternate, ternately divided, each segment again divided into numerous linear-ovate segments 3-6 mm. wide, uppermost leaves ternately divided into linear, entire segments, 4-11 cm. long, more or less pubescent, rarely farinose with few to numerous globules of exudate in the depressions of the puncticulate divisions. Mature heads (including florets) 5-10 mm. high, 10-15 mm. in diameter. Involucre broadly campanulate; involucral bracts variously pubescent, often farinose with globules of exudate, 18-24 in 2-3 series, reflexing with age, membranous margins, 4-6 mm. long, 1-2.5 mm. wide, obovate or lanceolate, apex acuminate, midrib weakly developed or absent. Receptacle somewhat convex, alveolate, 2-3 mm. in diameter. Ray florets 15-20, yellow, pistillate, fertile; ligule 4-4.5 mm. long, 1.5-3 mm. wide, oblong with a 3-lobed or undulate apex; tube 0.3 mm. in diameter, 1.3-1.6 mm. long, glandular-stipitate. Disc florets 90-140, perfect and fertile, yellow, regular or somewhat zygomorphic peripherally, 3-3.4 mm. long; tube and lower throat with few to numerous short stipitate glands; tube 0.3 mm. in diameter, 0.7-1 mm. long; throat campanulate, 1-1.5 mm. long; lobes 5, reflexed at maturity, 0.7-1.3 mm. long, throat-lobe ratio highly variable; anthers 1.5-1.8 mm. long, partially exserted at maturity; style branches flattened, 0.8-1.3 mm. long with prominent stigmatic lines along the upper margins, reflexed at maturity, apices obtuse with papillose enlargements; achenes 2.5-4 mm. long, narrowly obpyramidal, 4-sided, brown to black, occasionally striate, markedly hispid on the angles near the base and scatteredly pubescent above, the faces glabrous; pappus of 11-12 scarious oblanceolate scales with lacerate margins, 1-1.3 mm. long, 0.3-0.6 mm. wide, thickened at the base and with more or less well-developed midribs, the latter extending almost to the apices. Chromosome number, $n = 12$. Holotype (TEX). "31 mi. S. of Galeana," October 1, 1960, Nuevo León, Mexico, *M. C. Johnston & J. Crutchfield 5856*. (Isotypes to be distributed.)

DISTRIBUTION: Calcareous alluvial, sandy clay and shaly soils of Nuevo León and western Coahuila, Mexico, mostly along roadsides in arid or semi-arid habitats from 1500-3000 (-5000) ft. (Fig. 42). Principal flowering dates August-November.

Representative specimens of this new species have in the past been identified as *B. biternata.* It is superficially similar to *B. biternata* and *B. pedata* but clearly distinct. As indicated in the key to species, there are several morphological features as well as edaphic and geographic considerations which differentiate between the taxa. In addition, *B. biternata* and *B. pedata* occur mostly in grasslands at elevations from 3000-6000 ft., while *B. autumnalis* is found from 1500-3000 (-5000) ft., in desert or semi-arid habitats.

SPECIMENS EXAMINED: MEXICO. COAHUILA: 10 miles N. of Saltillo toward Piedras Negras, Oct. 14, 1959, *M. C. Johnston & J. Graham 4319* (TEX). NUEVO LEÓN: 13 miles out of Linares toward Iturbide, Sept. 30, 1960, *M. C. Johnston & J. Crutchfield 5836* (TEX). 1 mile W. of Iturbide, Sept. 30, 1960, *M. C. Johnston & J. Crutchfield 5843* (TEX). 5 miles below San Juan de Iturbide toward Linares, Oct. 9, 1949, *M. C. Johnston & J. Graham 4241* (TEX). Mamulique Pass, 23 miles S. of Sabinas Hidalgo, Nov. 8, 1960, *M. C. Johnston & J. Crutchfield 6045* (TEX). 13 miles W. of Linares toward Galeana, 1900 ft., Oct. 9, 1959, *M. C. Johnston & J. Graham 4246* (TEX). 15.5 miles S. of Sabinas Hidalgo toward Monterrey, 2000 ft., Nov. 10, 1959, *M. C. Johnston & J. Graham 4616* (TEX). Galeana, Arroyo Hondo, Aug. 1, 1935, *C. H. Mueller 2329* (ARIZ, F, GH, MICH, TEX). Horsetail Falls, 30 miles S. E. of Monterrey on Hwy. 85, Nov. 30, 1948, *W. M. Thompson 282* (TEX).

4. *Bahia biternata* Gray

Bahia biternata Gray, Pl. Wright. 2:95. 1853. Holotype examined (GH): "Gravelly hills near Ojo de Gavilan," August, 1851, New Mexico, *C. Wright 1256*. One probable isotype was also examined (UC). *Schkuhria biternata* (Gray) Gray, Proc. Am. Acad. 9:199. 1874. *Erio-*

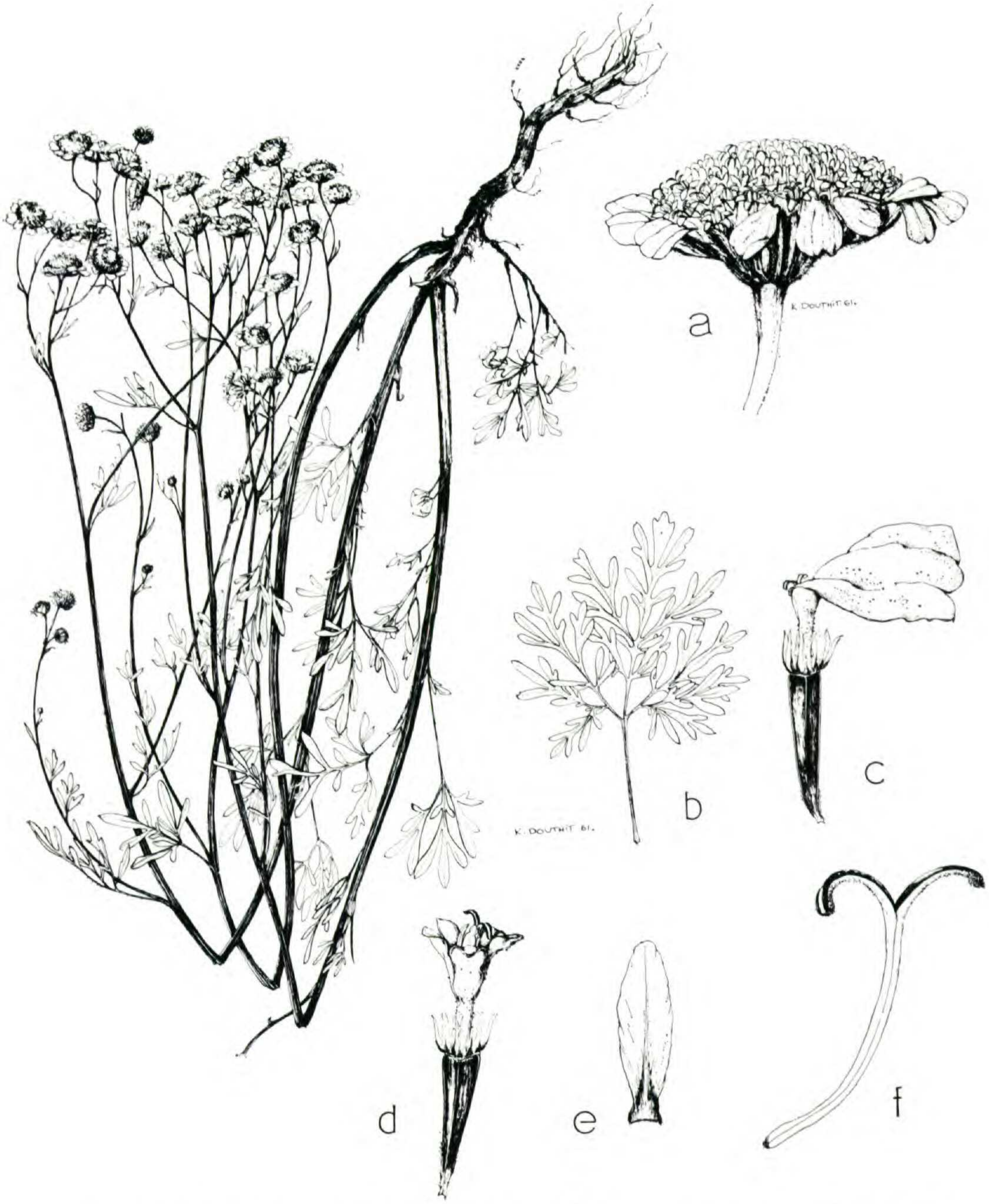

Fig. 47. *B. autumnalis* (Holotype, *Johnston 5856*, TEX). Entire plant, × 2/7. a. Head, × ca. 2. b. Mid-stem leaf, × ca. 2/7. c. Ray floret, × ca. 3. d. Disc floret, × ca. 3. e. Pappus scale, × ca. 15. f. Style branches, × ca. 9.

phyllum biternatum (Gray) Kuntze, Rev. Gen. Pl. 1:337. 1891. *Villanova biternata* (Gray) Woot. & Standl., Contrib. U. S. Nat. Herb. 19: 725. 1915.

Plants annual, 30-60(-100) cm. tall. Stem single and erect from a taproot (occasionally 2 or more major stems forming from the root-crown following injury), 1-4 mm. in diameter, loosely and paniculately branched, each terminal branch culminating in 1-4 monocephalic peduncles, lower stem pubescent and ribbed (rarely with stipitate glands), upper stem both pubescent and stipitate-glandular; peduncles 1-9 cm. long, variously short pubescent, farinose with few or no stipitate glands. Leaves opposite or nearly so at the extreme base, otherwise alternate, biternately divided into linear or ovate-lanceolate segments 1-3(-4) mm. wide, uppermost leaves ternately divided into 3 simple and entire segments, 2-4 cm. long (2-3 times as large in occasional robust plants), pubescent, farinose. Mature heads (including florets) 5-8 mm. high, 8-15(-20) mm. in diameter. Involucre broadly campanulate; involucral bracts pubescent and farinose, rarely with globules of exudate, 14-16 in 2 series with 1 or more outer bractlets, reflexing with age, membranous margins rarely tinged with purple, 2.7-5 mm. long, 1-2.5 mm. wide, obovate or oblong, apex obtuse, midrib weakly developed. Receptacle flat or slightly convex, alveolate, 1-1.5 mm. in diameter. Ray florets 8-14, yellow, pistillate, fertile; ligule 2.5-3.2(-10) mm. long, 1.6-2(-3) mm. wide, broadly spatulate or ovate with irregularly undulate or 3-lobed apex; tube 0.3 mm. in diameter, 1-1.3 mm. long with numerous stipitate glands. Disc florets 45-80, perfect and fertile, yellow, regular, 2.8-3.5 mm. long; tube and throat with numerous stipitate glands; tube 0.3 mm. in diameter, 1-1.3 mm. long; throat campanulate, 1.2-2 mm. long; lobes 5, reflexed at maturity, 0.5-0.7 mm. long; anthers 1.5-1.8 mm. long, partially exserted at maturity; style branches flattened, 0.6-0.8 mm. long with prominent stigmatic lines along the upper margins, reflexed at maturity, apices obtuse or truncate with a papillose enlargement; achenes 1.8-3.2 mm. long, narrowly obpyramidal, 4-sided, brown to black, hispid, the hairs about 0.2 mm. long (occasionally longer at the attenuate base); pappus of 10-14 scarious, obovate or oblanceolate scales; scales muticous, 0.5-1.4 mm. long, 0.4-0.6 mm. wide on the ray and exterior disc florets but lanceolate with an excurrent scabrous midrib, 1.2-2.3 mm. long and 0.2-0.5 mm. wide on the inner disc florets. Chromosome number not determined.

DISTRIBUTION: Granitic outcrops and open rocky slopes of south-central Arizona and S. W. New Mexico, mostly in grasslands and scrub oak habitats from 4000-5000 ft. (Fig. 44). Principal flowering dates May and September-October.

This species has apparently been little collected considering the small number of specimens which were available for study. *B. biternata* is closely related to *B. pedata* and *B. glandulosa,* and the three taxa have been variously confused by several workers. For a consideration of these relationships, see the discussions under the latter two species.

SPECIMENS EXAMINED: Whipple's Exploration for a Railway Rt. from Miss. R. to Pacific Ocean, near 35th parallel, Mule Springs, Aug., 1854, *J. M. Bigelow s.n.* (GH). ARIZONA. GILA CO.: Apache Trail and adjacent region, Horsedam Mesa, May 21, 1929, *A. Eastwood 17373* (CAS). Sierra Ancha Mts., lower Parker Creek Canyon, 4500 ft., Sept. 3, 1946, *F. W. Gould & R. K. Hudson 3834* (ARIZ). PINAL or GILA CO.: Summit of Superior-Miami Hwy., Oct. 10, 1926, *R. H. Peebles, G. J. Harrison & T. H. Kearney 3228* (ARIZ, US). PINAL CO.: Sacaton, May 8, 1926, *G. J. Harrison 1912* (ARIZ). NEW MEXICO. Ojo de Gavilan, Aug., 1851, *G. Thurber 1062* (GH). DONA ANA CO.: Valley of the Rio Grande, below Donana, w/o date, *C. C. Parry, J. M. Bigelow, C. Wright, & A. Schott 622* (US). GRANT CO.: 17 miles W. N. W. of Silver City, Sept. 25, 1944, *F. A. Barkley 14777* (TEX, UC).

5. *Bahia pedata* Gray

Bahia pedata Gray, Pl. Wright. 1:123. 1852. Holotype examined (GH): "Between western Texas and El Paso, N. Mex.," May-Oct., 1849, *C. Wright 327*. Probable isotype examined (GH). *Schkuhria pedata* (Gray) Gray, Proc. Am. Acad. 9:199. 1874. *Eriophyllum pedatum* (Gray) Kuntze, Rev. Gen. Pl. 337. 1891.

Plants annual (biennial?), 30-100(-120) cm. tall. Stem single and erect from a taproot (rarely 2 or more stems forming from the root-crown following injury), 2-6 mm. in diameter, paniculately branched, each terminal branch culminating in 1-4 monocephalic peduncles, ribbed, variously pubescent and glandular with numerous globules of exudate adnate to the surface and/or with numerous stipitate glands; peduncles 1-8 cm. long and stipitate-glandular. Leaves commonly in a close spiral arrangement on the lower stem, alternate, pedately divided into three segments, each lateral segment 2-parted (occasionally multifid), the middle segment of 3-7 lobes, ultimate lobes obovate or broadly oblong 2-5 mm. wide, uppermost leaves simple and entire or ternately divided into entire linear segments, 4-11 cm. long, pubescent, frequently farinose with numerous globules of exudate in the depressions of the puncticulate blade. Mature heads (including florets) 5-8 mm. high, 15-20 mm. in diameter. Involucre broadly campanulate; involucral bracts short stipitate-glandular, 13-17 in 2 series with 1 or more outer bractlets, reflexing with age, membranous margins rarely tinged with red or purple, scattered pubescence, 4-6 mm. long, 1.5-2.5 mm. wide, oblong-oblanceolate, apex obtuse, midrib weakly developed or absent. Receptacle somewhat convex, alveolate, 2.5-3 mm. in diameter. Ray florets 10-15, yellow, pistillate, fertile; ligule 5-6(-7) mm. long, 2.5-4 (-5) mm. wide, oblong with truncate irregular apex; tube 0.3-0.4 mm.

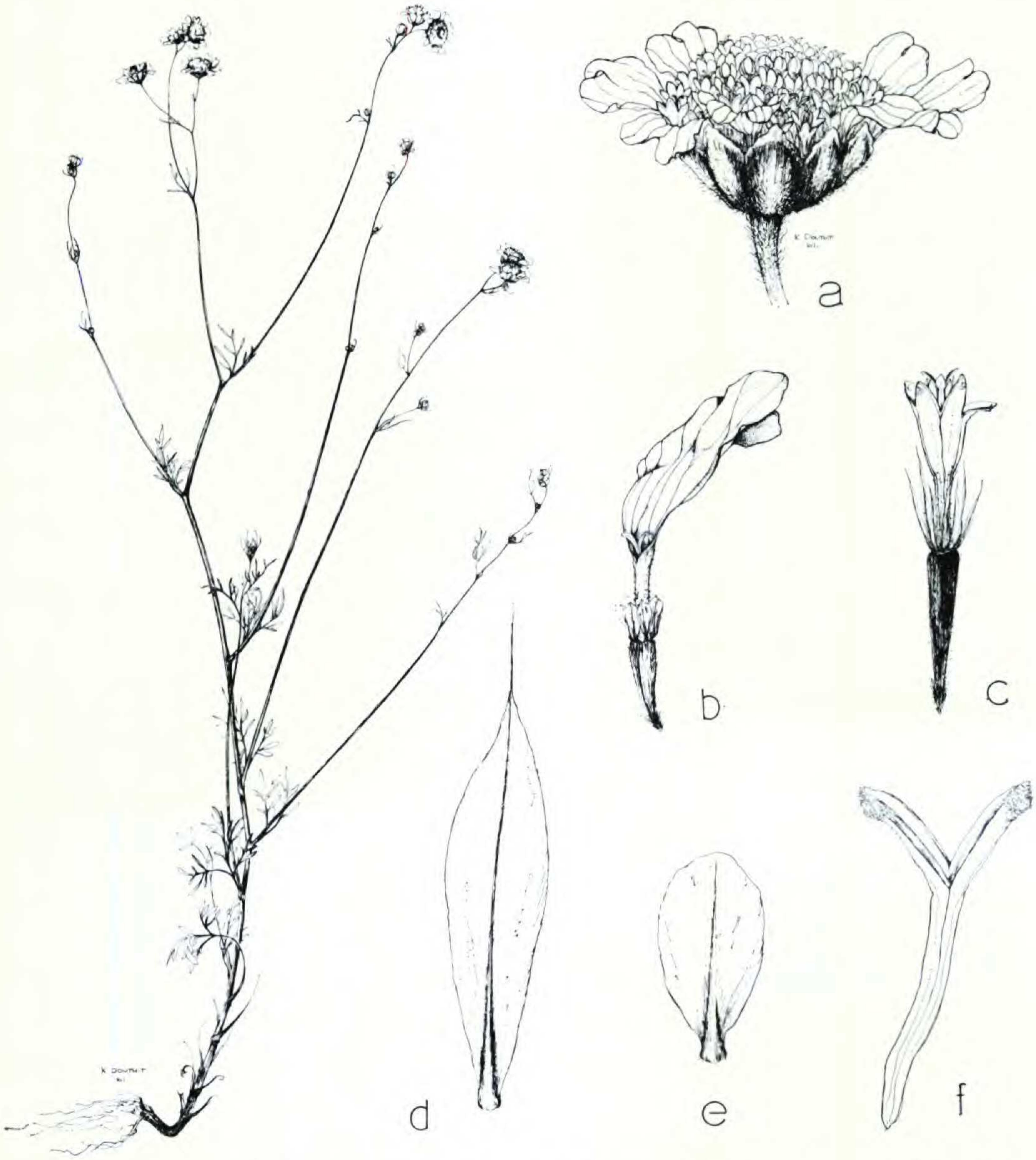

Fig. 48. *B. biternata* (*Thurber 1062*, GH). Entire plant, × 2/7. a. Head, × ca. 2. b. Ray floret, × ca. 3. c. Inner disc floret, × ca. 3. d. Pappus scale of inner disc floret, × ca. 18. e. Pappus scale of outer disc floret, × ca. 15. f. Style branches, × ca. 15.

in diameter, 1.5-2 mm. long with numerous stipitate glands. Disc florets 70-110, perfect and fertile, yellow, regular, 3-4.5 mm. long; tube and lower throat with numerous stipitate glands; tube 0.3-0.4 mm. in diameter, 1-1.8 mm. long; throat campanulate, 0.5-1 (1.5) mm. long; lobes 5, reflexed at maturity, 0.8-1.3 mm. long; anthers 1.5-2 mm. long, partially exserted at maturity; style branches flattened, 0.7-1 mm. long with prominent stigmatic lines along the upper margins, reflexed at maturity, apices obtuse with papillose enlargement; achenes 2.4-4 (-4.5) mm. long, narrowly obpyramidal, 4-sided, brown to black, often striate, hispid on the angles near the base, the hairs to 0.5 mm. long, merely hispidulous on the upper angles and sides; pappus of 10-15 scarious oblanceolate or spatulate scales; scales 1-1.5 mm. long, 0.3-0.5 mm. wide, thickened at the base with the midrib usually extending ½-¾ the length (occasionally minutely excurrent). Chromosome number, $n = 12$.

DISTRIBUTION: Rocky calcareous, sandy or igneous soils of grasslands in western Texas, southern New Mexico, and northern Coahuila and Chihuahua, 3000-6000 ft., (Fig. 42). Principal flowering dates June-November.

B. pedata is allopatric in a small portion of its range with *B. biternata*. In the past there has been much confusion in the recognition of specimens due to the inadequate circumscription of the taxa. Using the types as a point of reference, I found the distinguishing character of inner achenal pappus scales with excurrent midribs in *B. biternata* to be consistently correlated with other characters which mark the taxon (see the key to species). However, additional study of this particular problem should be conducted when a greater number of specimens of *B. biternata* is available. Populational analyses in western New Mexico and eastern Arizona should prove particularly important in this connection.

REPRESENTATIVE COLLECTIONS: NEW MEXICO. DONA ANA CO.: Mesa W. of Organ Mts., Aug. 29, 1902, *E. O. Wooton s.n.* (ARIZ, US). EDDY CO.: 5 miles N. of Carlsbad, Sept. 15, 1956, *J. W. MacSwain s.n.* (UC). GUADALUPE CO.: 2.7 miles E. of Newkirk, Aug. 17, 1953, *U. T. Waterfall 11755* (TEX, UC). QUAY CO.: Tucumcari, Aug. 30, 1910, *G. L. Fisher 8* (US). SIERRA CO.: 2 miles E. of Lava, Casa Grande, July 7, 1933, *S. B. Benson 343* (UC). TEXAS. BREWSTER CO.: Chisos Mts., Aug. 1, 1931, *C. H. Mueller 8228* (GH, TEX, US). CULBERSON CO.: Van Horn, Sept. 5, 1925, *B. C. Tharp 3885* (TEX, US). EL PASO CO.: El Paso, Sept. 29, 1884, *M. E. Jones 4340* (ARIZ, F, GH, US). HUDSPETH CO.: 8 miles E. of Sierra Blanca, 4600 ft., Aug. 13, 1940, *F. Shreve 9555* (ARIZ, MICH, UC). JEFF DAVIS CO.: Musquiz Canyon, May 9, 1941, *B. H.*

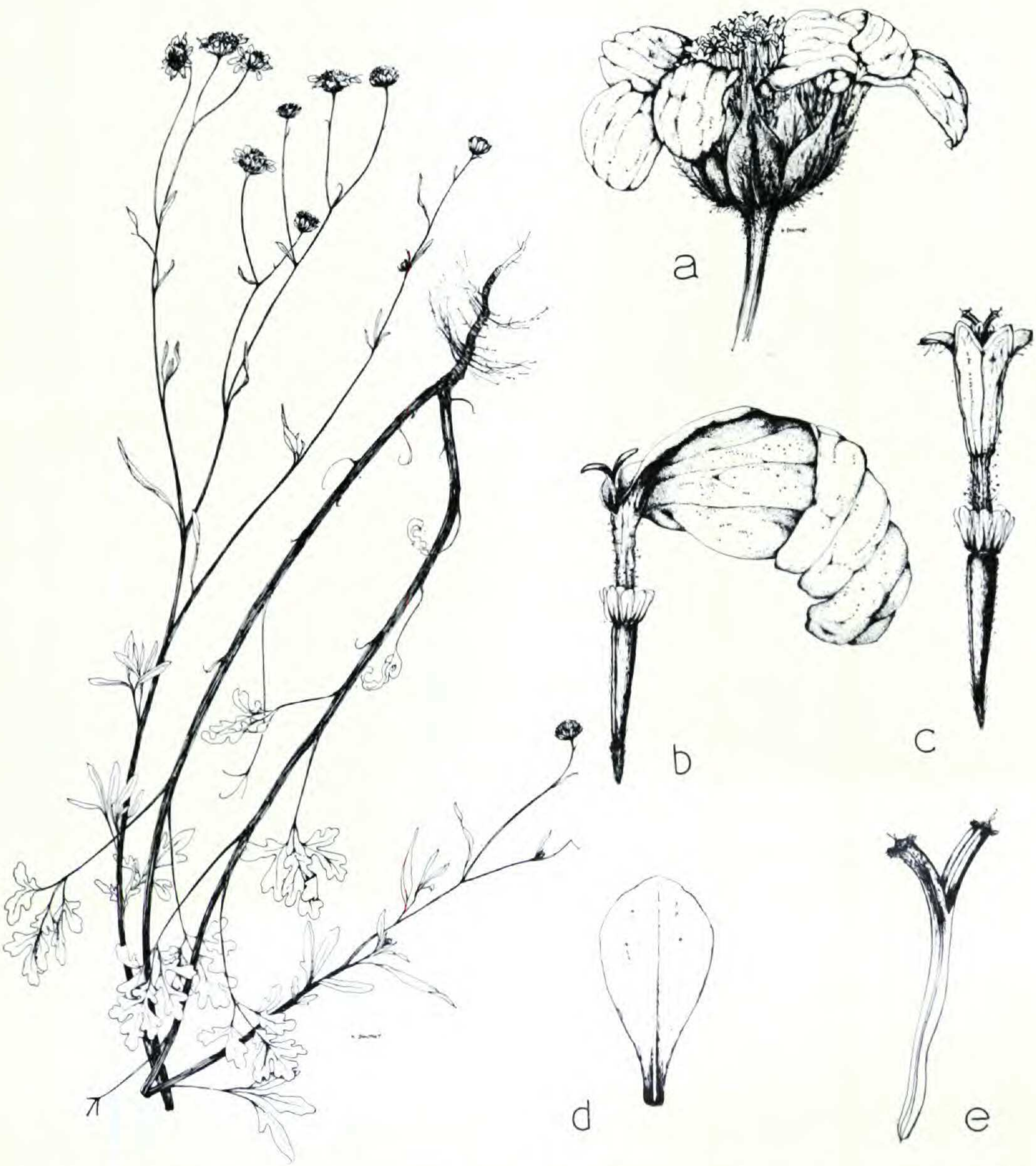

Fig. 49. *B. pedata* (*Ellison 16*, TEX). Entire plant, × 2/7. a. Head, × ca. 2. b. Ray floret, × ca. 5. c. Disc floret, × ca. 6. d. Pappus scale, × ca. 12. e. Style branches, × ca. 11.

Warnock 751 (ARIZ, GH, TEX). PRESIDIO CO.: Marfa, San Esteban Lake, July, 1936, *L. C. Hinckley s.n.* (F, GH, TEX). REEVES CO.: 20 miles E. of Balmorhea on Hwy. 290, Sept. 11, 1959, *W. L. Ellison & B. L. Turner 16* (TEX).

MEXICO. CHIHUAHUA: 78 miles N. of Parral on Hwy. 45, 5100 ft., Sept. 4, 1960, *W. L. Ellison & A. Garcia 139* (TEX). Road from Laguna Palomas to Jimenez via Escalon, Sept. 22, 1938, *I. M. Johnston 7835* (GH). 2 miles S. of San Fernando, 40 miles N. E. of Camargo, Sept. 25, 1938, *I. M. Johnston 7942* (GH). Northeastern part of state, 10 miles E. of Chapo on road from Ojinaga S. E. to San Carlos between Alamos Chapo and Alamitos, Aug. 8, 1940, *I. M. Johnston & C. H. Mueller 17* (GH). Meoqui, Aug. 6, 1936, *H. LeSueur 1235* (F). Plains, Aug. 17, 1885, *C. G. Pringle s.n.* (F). Near Chihuahua, Oct. 24, 1885, *C. G. Pringle 308* (DS, F, GH, MICH, US). 16 miles N. of Escalon, 4400 ft., Sept. 22, 1938, *F. Shreve 8860* (ARIZ, US). Oct., 1911, *E. Stearns 52* (F). 10 km. S. of Rancho de Encinillas, July 6, 1941 *R. M. Stewart 704* (GH). 8 miles N. of San Lucas on road to Chihuahua, Aug. 8, 1939, *S. S. White 2328* (MICH). COAHUILA: Western part of state, Sierra de San Antonio, Sept. 2-3, 1940, *I. M. Johnston & C. H. Mueller 935* (GH). Western part of state between San Rafael and San Vicente, Sept. 8, 1940, *I. M. Johnston & C. H. Mueller 1056* (GH). Del Carmen Mts., Sept. 13, 1936, *E. G. Marsh, Jr. 904* (F, TEX). 24 km. N. of Castillon, close to Chihuahuan boundary, June 15, 1941, *R. M. Stewart 540* (GH). Villa Acuña, near Santo Domingo, July 4, 1936, *F. L. Wynd & C. H. Mueller 465* (ARIZ, GH, US).

6. *Bahia ambrosioides* Lagasca

Bahia ambrosioides Lag., Gen. et. Sp. Nov. 30. 1816. Holotype: Chile, "habitat circa Concepción urbem in Chilensi Regno. (V.S.)." The type, if preserved, should be located in the Instituto Botánico Antonio Jose Cavanilles, Madrid, Spain, but according to Dr. Elena Paunero (personal communication), curator of the herbarium, no such specimen could be found in their collections. *Stylesia ambrosioides* (Lag.) Nutt., Trans. Am. Phil. Soc. Ser. II 7:377. 1841. (Nuttall knowingly proposed the new generic name *Stylesia* for the South American elements of *Bahia* and, contrary to the present Code, restricted the name *Bahia* to the North American species.) *Eriophyllum ambrosioides* (Lag.) Kuntze, Rev. Gen. Pl. 1:336. 1891.

Achyropappus maritimus Poepp. ex DC., Prod. 5:657. 1825. (In synonymy).

Stylesia puberula Nutt., Trans. Am. Phil. Soc. Ser. II 7:377. 1841.

Plants perennial, suffruticose, 30-100 cm. tall. Basal stems furrowed, somewhat farinose, upper stems glandular-pubescent and/or viscid with few to numerous leaves and leafy shoots, the branches striate, glandular, or occasionally pilose; peduncles 1-3(-5) cm. long, glandular. Leaves opposite, ternately bipinnatifid to multifid with narrow linear or ovate-oblanceolate segments 0.5-5 mm. wide, petioles partially clasping the stem, 1-3 cm. long, nearly glabrous to pilose, occasionally somewhat farinose, impressed punctate with globules of exudate in the depressions. Mature heads (including florets) 5-8 mm. high, 15-20 mm. in diameter. Involucre turbinate-campanulate; involucral bracts pubescent and glandular with an exudate often appearing as a pulverulence, 5-8 in 1-2 series (with 1 or 2 occasional small outer bractlets), reflexing with age, 6-8 mm. long, 2-4.5 mm. wide, broadly ovate, the margins membranous, apex obtuse or somewhat acute, midrib either weakly discernible or absent. Receptacle somewhat convex, alveolate (occasionally somewhat fimbrillate), 1-2.5 mm. in diameter. Ray florets 4-9, white or cream-colored, pistillate, fertile; ligules 5-8 mm. long, 2-5 mm. wide, obovate with notched, undulate or irregularly-lobed apices; tube about 0.5 mm. in diameter, 2-3 mm. long, glandular-pubescent, the hairs to 0.4 mm. long. Disc florets 30-70, perfect and fertile, yellow, regular, 2-4(-5) mm. long; tube stipitate-glandular, 1-1.8(-2.3) mm. long, about 0.5 mm. in diameter; throat campanulate to funnelform, 0.5-1.5 mm. long; lobes 5, reflexed at maturity, equal, 0.5-1.5 mm. long; anthers 1.3-2 mm. long, partially exserted at maturity; style branches flattened, 1-2 mm. long with well-defined stigmatic lines along the upper margin, reflexed at maturity, apices obtuse with papillose enlargements; achenes 2-4.5 mm. long, narrowly obpyramidal, 4-sided, brown sparingly pubescent; pappus of 7-10 scarious ovate or obovate colorless purple-tinged scales; scales 0.7-2.3 mm. long, 0.3-1 mm. wide, thickened at the base but almost never with a distinct midrib. Chromosome number not determined.

DISTRIBUTION: Rocky arid slopes, open crests and canyons and sandy dunes from sea level to 3600 feet, mostly along the coast of Chile from about latitude 20° to 37° S. (Fig. 50). Principal flowering dates July-February.

Nuttall, when proposing the illegitimate genus *Stylesia*, indicated the existence of two South American species, *S. ambrosioides* and *S. puberula*. He distinguished the former as having leaves trifid or twice trifid and puberulous as opposed to leaves ternately bipinnatified and minutely pubescent, and achenes twice the length of the pappus as opposed to achenes just half as long but equal in length to the pappus. I could make no adequate separation of the specimens on the basis of leaf character, and a careful analysis of achene length and relative achene-pappus length disclosed no basis for the recognition of two taxa. Two floral characters which are worthy of note, but which showed no meaningful systematic pattern, were the markedly different disc tube lengths and the ratio of the pappus length to corolla length

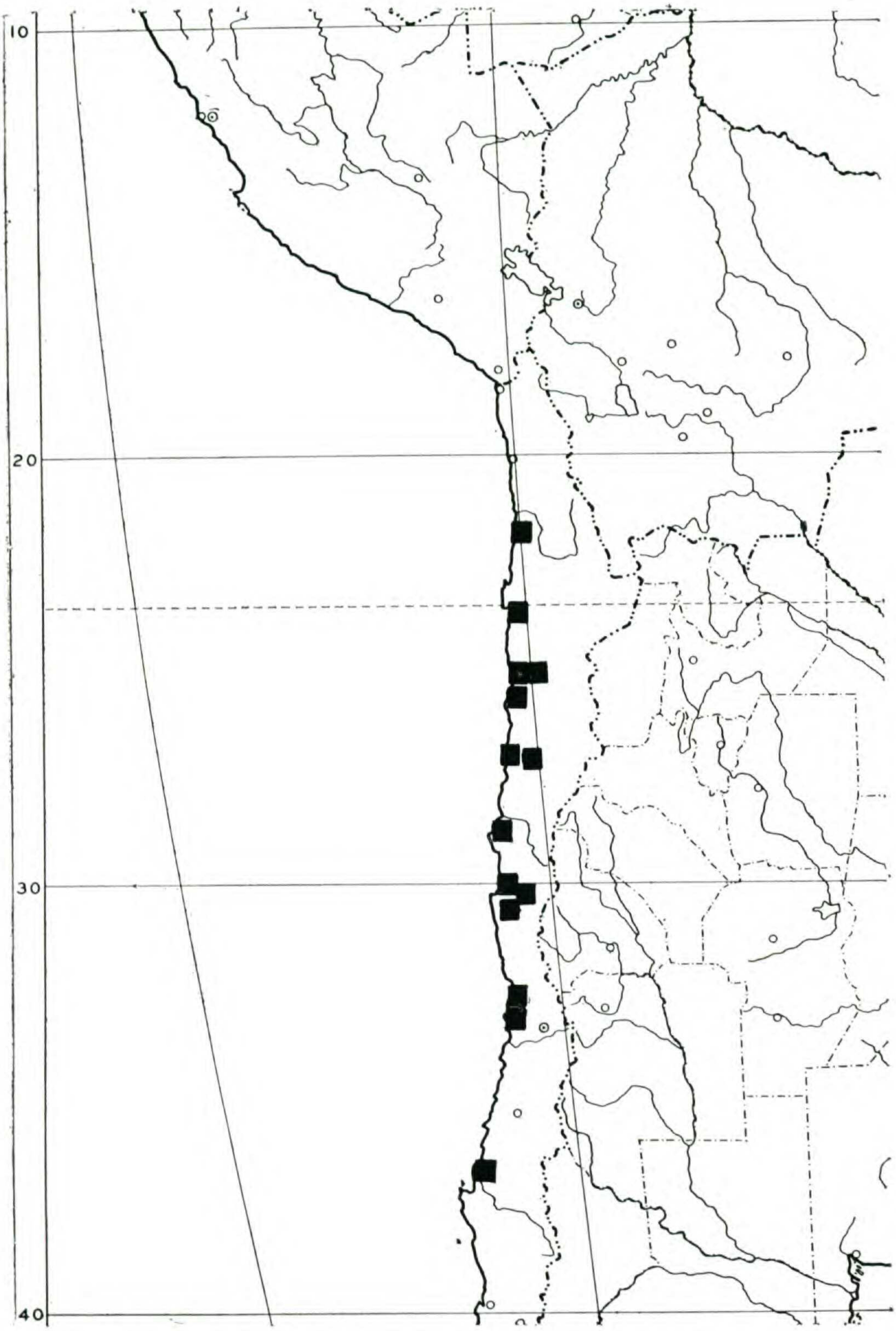

Fig. 50. Map of portion of west coast of South America showing distribution of *B. ambrosioides*.

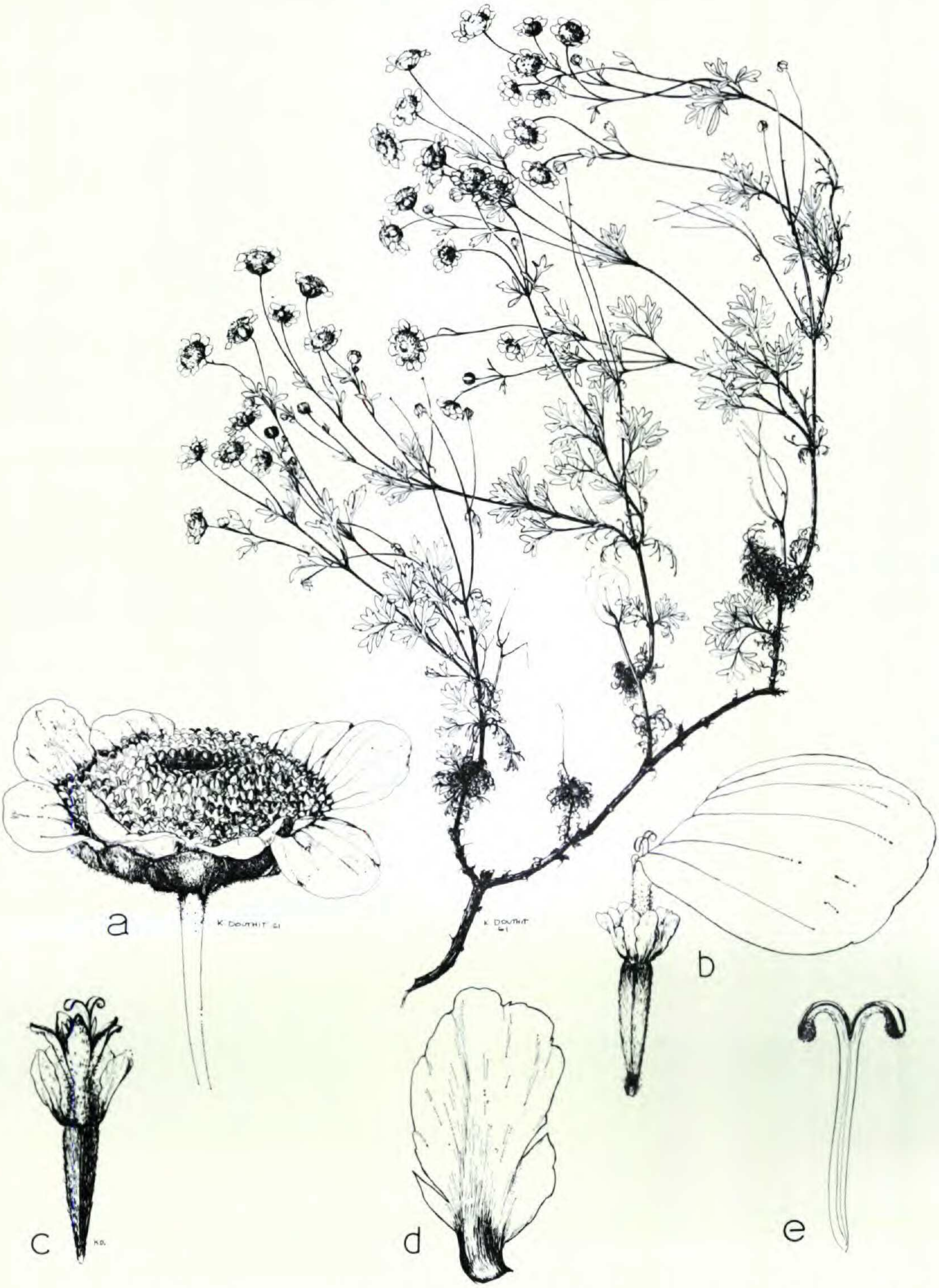

Fig. 51. *B. ambrosioides* (*Werdermann 811,* GH). Entire branch, × 2/7. a. Head, × ca. 2. b. Ray floret, × ca. 3. c. Disc floret, × ca. 3. d. Pappus scale, × ca. 12. e. Style branches, × ca. 9.

of the disc florets, this varying from 0.2-0.9. A single specimen was noted which had lanceolate pappus scales with distinct midribs *(Looser 4265)*.

One sheet examined *(I. M. Johnston 4913)* was of particular interest. On the label, Johnston indicated this to be a new variety (unpublished) with the following notation. "This collection is peculiar because of its very extreme glandularity and because it comes from so very far inland away from the coast." The total character of the several branches on the sheet is within the range of variation which I found for the species except for the degree of glandulosity and the presence of an exceptionally long tube on the disc florets of one plant (1.7-2.3 mm. long). On the same sheet, however, was a specimen with tubular dimensions within the normal limits.

REPRESENTATIVE COLLECTIONS: CHILE. ACONCAGUA: Las Salinas near Viña del Mar, July 29, 1928, *G. Looser 713* (GH). ANTOFAGASTA: DEPTO. TALTAL, vicinity of Aguada de Miguel Diaz, about 24°35′ S., Dec. 1-4, 1925, *I. M. Johnston 5326* (GH, US). DEPTO. TOCOPILLA, Tocopilla, 6 km. N., Oct. 18, 1925, *I. M. Johnston 3587* (GH). DEPTO. TALTAL, vicinity of Paposo on hill directly back of Punta Grande, Nov. 29, 1925, *I. M. Johnston 5226* (GH, US). Antofagasta, 100-300 m., April 3, 1925, *F. W. Pennell 13023* (F, GH). DEPTO. TALTAL, Taltal, 500 m., Oct., 1925, *E. Werdermann 811* (CAS, F, GH, UC, US). ATACAMA: DEPTO. COPIAPO, vicinity of Caldera, Oct., 1894, *E. E. Gigoux 24* (GH). DEPTO. CHANARAL, vicinity of Puerto de Chanaral in hills back of El Barquito, Oct. 28-29, 1925, *I. M. Johnston 4791* (GH, US). DEPTO. COPIAPO, Quebrada San Miguel above Los Marayes, 1200 m., Nov. 7, 1925, *I. M. Johnston 4913* (GH). Desert of Atacama, Sept.-Oct., 1890, *T. Morong 1130* (F, GH, MICH, US). COQUIMBO: DEPTO. OVALLE, Fray Jorge, 30°40′ S. lat., Sept. 26, 1935, *C. Munoz B111* (GH). DEPTO. LA SERENA, Sept. 15, 1935, *C. Munoz B-27* (ex part.) (GH). Valley of Rio Turbio near Dieguitas, 700 m., Nov. 20, 1935, *J. West 3914* (GH, UC). Coquimbo, July-Aug., 1856, *W. H. Harvey s.n.* (US). Coquimbo, Feb., 1903, *G. T. Hastings 591* (UC, US). DEPTO. ELQUI, Hacienda Pangue, 20-25 km. S. of Vicuña on road to Hurtado, 1200 m., Oct. 13, 1940, *G. Looser 4265* (GH). Masefuera, rocky coast near Casas, March 13, 1917, *C. & I. Skottsberg 443* (US). SANTIAGO: Llolleo, dunes, Aug., 1921, *G. Montero 34* (GH). Santiago, Dec., 1922, *Claude-Joseph 2225* (US). Serena, Oct., 1927 *Claude-Joseph 5095* (US). VALPARAISO: Quintero, 90 m., Sept., 1923, *E. Werdermann 36* (CAS, F, GH, UC, US). Valparaiso, 1888 (US). Valparaiso, 1829, *Bertero 839* (GH). Valparaiso, Oct., 1925, *Claude-Joseph 3645* (US). Valparaiso, *Gay 197* (GH). Valparaiso, Feb., 1846, *Gaudichaud 160* (DS). Near Valparaiso, Sept. 22, 1914, *Mr. & Mrs. J. N. Rose 19152* (US). Valparaiso, *Wilkes s.n.* (US).

7. *Bahia bigelovii* Gray

Bahia bigelovii Gray, Torr. Bot. Mex. Bound. 96. 1859. Holotype examined (GH): "Valley of the Limpio," W. Texas, July, 1852, *Bigelow s.n. Schkuhria bigelovii* (Gray) Gray, Proc. Am. Acad. 9:199. 1874. *Eriophyllum bigelovii* (Gray) Kuntze, Rev. Gen. Pl. 1:337. 1891.

Plants annual, 15-35 cm. tall. Stem erect from a slender taproot, 1-2 mm. in diameter, branched, each terminal branch culminating in 1-4 monocephalic peduncles, internodes 4-8(2.5) cm. long, ribbed sparingly pubescent with infrequent globules of exudate adnate to the surface; peduncles 3-10 cm. long, sparingly pubescent at the base but becoming tomentose and with stipitate glands and globules of exudate near the top. Leaves opposite becoming alternate on the upper stems, 3-parted into linear entire or secondarily divided, the segments 1(-2) mm. wide, 1.5-5 cm. long, sparingly pubescent, impressed punctate or puncticulate with globules of exudate in the depressions. Mature heads (including florets) 4-7 mm. high, 8-16 mm. in diameter. Involucre broadly campanulate; involucral bracts more or less pubescent (rarely with stipitate glands) and with numerous globules of exudate, 10-14 (-18) in 2 series, reflexing with age, the margins membranous, rarely tinged with purple, 3.5-4.5 mm. long, 1-1.6 mm. wide, obovate, the apex acute, acuminate or obtuse and the midrib weakly discernible or absent. Receptacle flat, alveolate, 0.7-1.2 mm. in diameter. Ray florets 5-9, yellow, pistillate, fertile; ligule 3.5-4.5 mm. long, 1.5-3 mm. wide, elliptical with a truncate irregularly undulate apex; tube 0.2-0.3 mm. in diameter and 0.6-1 mm. long with few to numerous stipitate glands. Disc florets 50-85, perfect and fertile, yellow, regular or somewhat zygomorphic peripherally, 2.5-3 mm. long; tube stipitate-glandular, 0.2-0.3 mm. in diameter, 0.8-1.2 mm. long; throat broadly campanulate, 0.8-1.2 mm. long; lobes 5, reflexed at maturity, 0.5-0.8 mm. long; anthers 1-1.3 mm. long, partially exserted at maturity; style branches flattened, 0.5-0.7 mm. long, reflexed at maturity, apices obtuse with papillose enlargements; achenes 2-2.5(-4.3) mm. long, obpyramidal, 4-sided, brown to black, hispid at the extreme base with hairs 0.1-0.3 mm. long, the upper portion nearly glabrous with only a few appressed hairs; pappus of 8(-9) broadly obovate scarious scales; scales 0.5-1.1 mm. long, 0.4-0.6 mm. wide, 1/2-2/3 the length of the tube, thickened at the base with the midrib extending about 1/2 the length of the scale. Chromosome number, $n = 11$.

DISTRIBUTION: A localized species restricted to moist igneous soils mostly along streams in canyons of Brewster, Jeff Davis and Presidio counties, Texas, 5000-6000 ft. (Fig. 53). Principal flowering dates June-October.

REPRESENTATIVE COLLECTIONS: TEXAS. BREWSTER CO.:

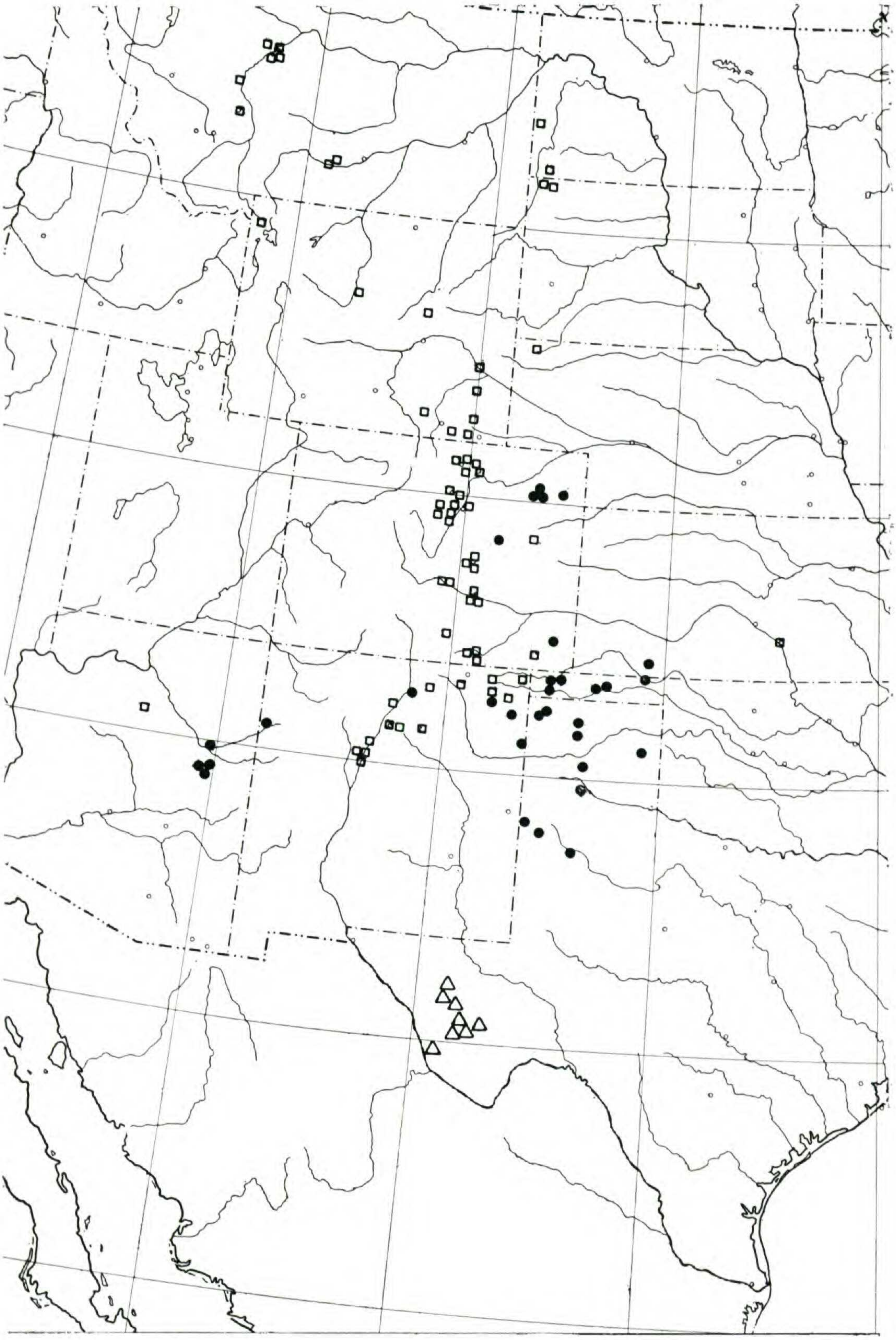

Fig. 52. Map showing distribution of *B. bigelovii*, open triangles; *B. oppositifolia*, open squares; *B. woodhousei*, closed circles.

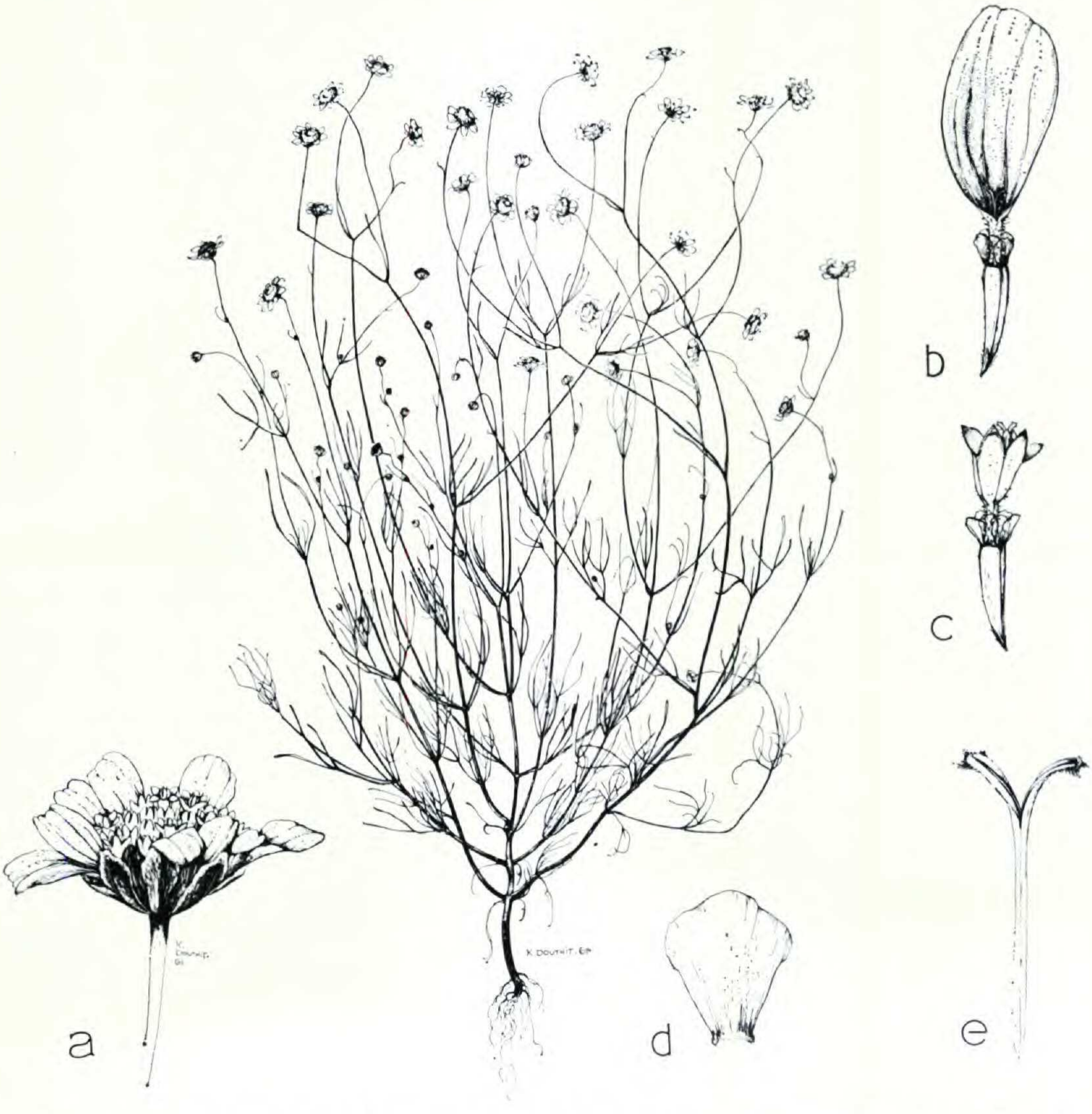

Fig. 53. *B. bigelovii* (*Young s.n.*, UC). Entire plant, × 2/7. a. Head, × ca. 2. b. Ray floret, × ca. 4. c. Disc floret, × ca. 4. d. Pappus scale, × ca. 12. e. Style branches, × ca. 12.

Paisano Pass, Sept. 4-8, 1925, *B. C. Tharp 3777* (TEX, US). Alpine, McIntire Hill, Aug. 5, 1938, *B. H. Warnock T497* (TEX, US). JEFF DAVIS CO.: Mt. Livermore, Davis Mts., Oct. 19, 1935, *O. E. Sperry T371* (LL, US). Lower Fern Canyon N. of Alpine, Aug. 26, 1940, *B. H. Warnock W883* (ARIZ, GH, TEX). PRESIDIO CO.: Chinati Mt., Watts Ranch, 5000 ft., Aug. 27, 1943, *L. C. Hinckley 2838* (LL).

To be concluded